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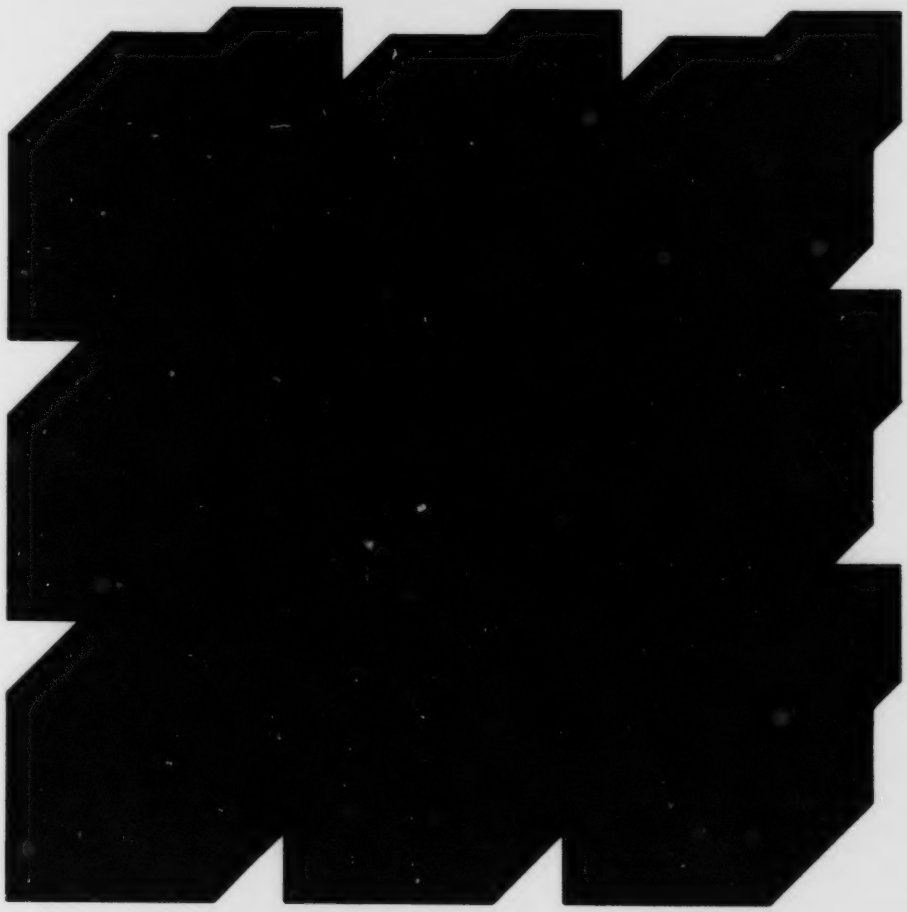

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DISCUSSION PAPER NO. 314

Marginal Effective Tax Rates for the Oil Industry in Alberta, 1965-84

by Mireille Ethier and
Dominique Simard

Mireille Ethier is with the federal Department of Finance; Dominique Simard is pursuing a Ph.D. degree at Queen's University

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RÉSUMÉ

Le but du présent document est de calculer les taux réels marginaux de l'impôt payé par l'industrie pétrolière albertaine durant la période de 1965 à 1984. À cette fin, les expressions du coût du capital pour l'utilisateur sont dérivées du modèle théorique d'une entreprise maximisant les bénéfices. Les fonctions de production utilisées sont particulières au secteur pétrolier et sont différentes pour les quatres stades de la production : la prospection, la mise en valeur, l'extraction et les éléments d'actifs non renouvelables.

Nos résultats indiquent que les impôts sur le revenu des sociétés ont subventionné, à la marge, l'investissement dans l'industrie pétrolière à chacun des quatre stades de production. Même en tenant compte, dans les calculs, des redevances versées à la Couronne, les taux réels marginaux de l'impôt sur les sociétés demeurent très faibles. Par contre, l'impôt sur le revenu des particuliers prélevé sur le revenu du capital investi dans le secteur pétrolier a presque égalé, en valeur absolue, les subventions aux sociétés. Une fois combinés, les taux d'impôt marginaux des sociétés et des particuliers sont donc presque nuls.

SUMMARY

The purpose of this paper is to calculate marginal effective tax rates for the Alberta oil industry for the period 1965-84. In order to do so, expressions for the user cost of capital are derived from a theoretical model of a profit maximizing firm. The production functions used are specific to the oil sector and are different for the four production stages: exploration, development, extraction, and depletable assets.

Our results show that the corporate income taxes have subsidized, at the margin, investment in the oil industry at all four stages of production. Even when royalties paid to the Crown are included in the calculations, marginal effective corporate tax rates stay very low. The personal income tax, on the other hand, has taxed income from capital invested in the oil sector nearly offsetting corporate subsidies. The combined corporate and personal marginal tax rates are therefore close to zero.

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INTRODUCTION

Energy policy has occupied a preponderant place in Canada since 1973 because the two oil price shocks of 1973 and 1979 have given rise to large economic rents. Rents that governments tried to tax away.

Over the period 1973-86, both levels of government, with competing claims on natural resource revenues, have introduced a vast array of taxes and fiscal incentives, the combined effect of which is unknown. In 1986, the dramatic decrease in oil prices have prompted governments to phase-out taxes in order to prevent exploration and development activity to stop.

Several studies have attempted to estimate the overall fiscal burden facing firms. Some of these studies focused on average tax rates while others computed marginal tax rates (Boadway, Bruce and Mintz (1984), Department of Finance (1985), Daly et al (1985)). However, few of these studies have looked specifically at the non-renewable resource sector (with the exception of Gaudet and Lasserre, 1984).

Boadway, Bruce, McKenzie and Mintz (1986) partially fill this gap by looking at the taxation of the mining sector in Quebec and Ontario. This paper differs from theirs in two respects. First, the model we use is specific to the oil industry and differentiates between activity carried at the exploration, development and extraction stages. Second, we work in a time-series framework and thus have modeled all the tax changes the oil industry has been subject to over the last twenty years.

Calculations of marginal effective tax rate are useful for three reasons. First, they show policy-makers the existing biases built into the tax system. Second, they provide us with more accurate proxies for the fiscal burden on capital within the framework of general equilibrium analyses wherein marginal distortions are important. Third, they give us values for the user costs of capital that can be used in econometric analysis of investment demand equations.[1] We will be concentrating on the first application in this paper.

This study presents marginal effective tax rates both at the corporate and personal levels. Such calculations not only show the cumulative effects of all the provisions of the tax system, they also point in the direction of possible incentives to misallocate resources. It includes the corporate tax for the period 1965-84, the property tax for the subperiod 1972-81,

and sales tax for 1981. At the household level, only taxes falling on capital income are included.

The results indicate that the fiscal treatment of the oil industry -- including corporation income taxes and royalties -- resulted in very low, or even negative, marginal effective tax rates. When the taxes at the personal level were added, marginal effective tax rates were higher, yet close to zero. However, for firms not eligible to the Alberta Royalty Tax Credit anymore, corporate and personal marginal effective tax rates were positive. This implies that new investment was effectively taxed when undertaken by such firms. The tax system thus embodied a bias towards investment undertaken by smaller firms.

The paper is organized as follows. Prior to the presentation of the main empirical results in Chapter Four, the general methodology of cost of capital for the resource sector and its adaptation to the fiscal content of the Alberta oil industry are displayed in Chapter One and Two respectively. A description of the fiscal context is in Chapter Three. Derivation of the model and results pertaining to special cases are found in the Appendices.

Note

1 Empirical analysis of investment has focused mainly on average effective tax rates as determinants of investment. Chirinko (1985) provides a good survey of the existing literature on taxation and investment.

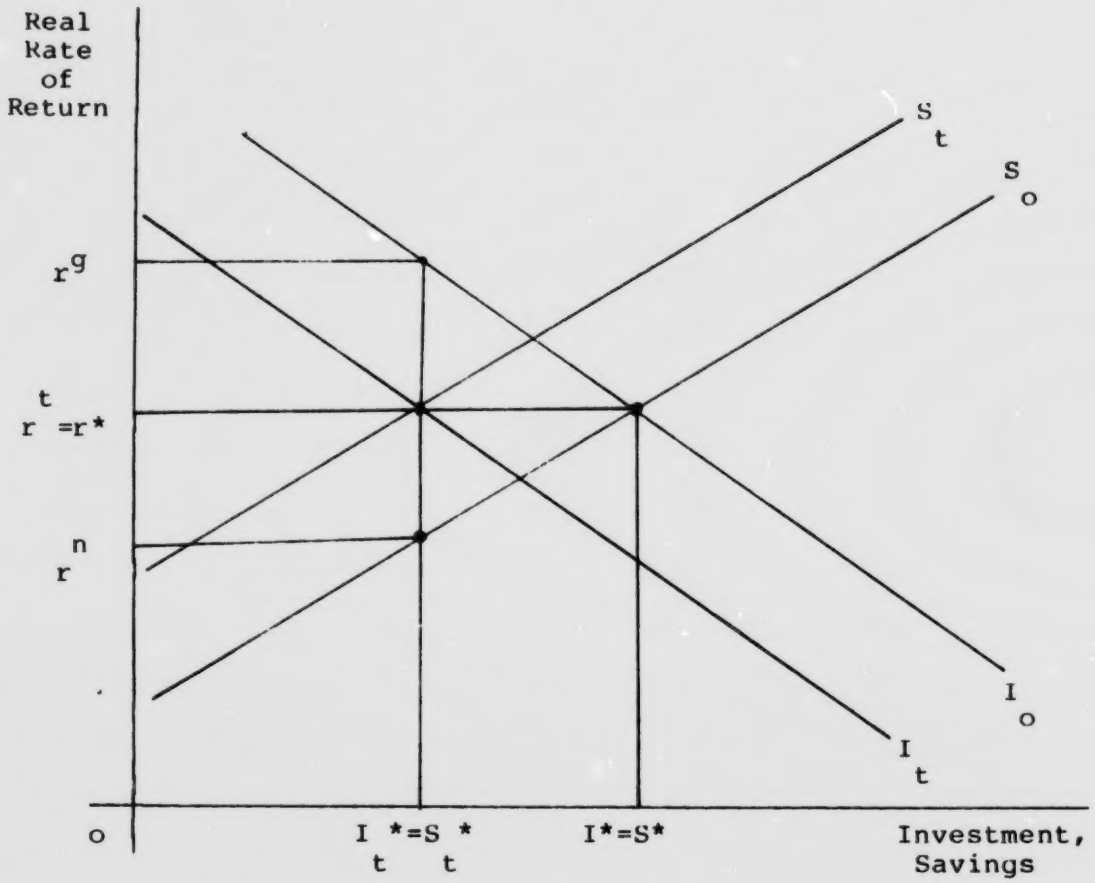
1 METHODOLOGY

Consider, first, a world without taxes. Figure 1-1 shows a capital market equilibrium determined by the intersection of a supply of funds schedule (S_o), relating savings to various rates-of-return, and a demand for funds schedule (I_o), relating levels of investment to various rates-of-return to capital.

Let us now introduce taxes. Both the demand and the supply of funds shift to the left by amounts determined by the relative share of taxes on capital borne by firms and households. The new schedules, S_t and I_t, determine a new equilibrium characterized by r^t and $I_t^* = S_t^*$. However, since the nominal return to savings is taxed at the personal level, savers receive less than r^t. They earn r^t minus personal taxes paid or r^n. Firms, on the other hand, have to pay the real cost of finance r^t plus corporate taxes or r^g.[1]

The difference between r^g and r^n is defined as the total marginal tax rate and is composed of the corporate tax rate, $r^g - r^t$, and the personal tax rate, $r^t - r^n$. In other words, r^g represents the before-tax real rate-of-return a firm has to get in order to undertake the marginal investment. The after-tax real

Figure 1-1


Real
Rate
of
Return
S_t
S_o
r^g
$r_t = r^*$
r^n
I_o
I_t
o
$I^*_t = S^*_t$
$I^* = S^*$
Investment,
Savings

rate-of-return a saver has to receive in order to provide funds for the marginal investment is r^n.[2] The calculation of marginal effective tax rates requires values for r^g, r^t, and r^n.

A. After-Tax Real Rate-of-Return to Savings (r^n)

The expression for the after-tax real rate of return to savings comes from observing market rates of return and deducting from them the appropriate taxes facing households. Assuming households acquire debt and equity from firms in the same proportion as each firm finances its investments, we get[3]:

$$r^n = \beta i (1-m) + (1-\beta) \{a \rho (1-c) + (1-a) [(\rho-\pi)(1-\theta) + \pi (1-c)]\} - \pi \quad (1)$$

where:

β : proportion of financing done by debt,

i : nominal interest rate on debt,

m : marginal effective personal tax rate on interest income,

a : proportion of equity financed by retained earnings,

ρ : nominal rate of return on equity,

c : marginal effective personal tax rate on accrued capital gains,

π : expected inflation rate,

θ : marginal effective personal tax rate on dividend income.

Savers can provide financing through either debt or equity. The proportion of debt financing is β, the nominal interest rate is i, and the tax rate on interest income is m, therefore savers receive a real after-tax return of $\beta i (1-m) - \pi$. The proportion of financing done through equity is $(1-\beta)$, which is subdivided into retained earnings and new issues with proportions of a and $(1-a)$, respectively. A nominal capital gain, ρ, (per dollar of retained earnings) accrues to savers. The real after-tax return on retained earnings is therefore $\rho (1-c) - \pi$. On new share issues, there is a dividend stream equal to the real rate of return on equity, $(\rho-\pi)$, taxed at the dividend tax rate, θ, plus a capital gain due to an inflation-induced increase in share price taxed at the capital gain tax rate c. The real after-tax rate of return on equity financed by new share issues is $[(\rho-\pi)(1-\theta) + \pi(1-c)] - \pi$.

B. Real Cost of Finance (r^t) and Before-Tax Real Rate-of-Return to Capital (r^g)

The before-tax real rate-of-return to capital (r^g) is more difficult to measure. To observe it directly would require one to identify the marginal investment project and measure its rate of return which is impossible to do. Instead, we derive from a theoretical model of a profit-maximizing firm an expression for

the marginal product of capital (the so-called user cost of capital) which is then converted into a rate-of-return expression.

Using the neoclassical investment model developed by Jorgenson[4], one can derive an expression for the user cost of capital:[5]

$$F_K = r^g + \delta \qquad (2)$$

where:

F_K : marginal value product of a given input used to undertake an investment project,

r^g : cost (including taxes) of the capital used in that project,

δ : economic depreciation of the capital used in that project.

Equation (2) shows that for the marginal investment project, the marginal revenue product of an input equals its cost.

The theoretical model used to derive expressions for F_K for the oil industry in Alberta is different from the models used in the existing literature on tax rates in the manufacturing sector (Boadway, Bruce, and Mintz (1984)) but is similar to the one used for the mining sector by Boadway, Bruce, McKenzie, and Mintz (1986). Chapter 2 presents the model.

Notes

1 Boadway, Bruce, and Mintz (1984) provide a more general exposition of the methodology by allowing the real cost of finance determined by the demand and supply of fund schedules to differ from an exogenously given market cost of finance (the open-economy assumption). This is not done here in order to simplify the presentation.

2 In Daly, Jung, Mercier, and Schweitzer's methodology (1985), r^g is labeled p, r^t is labeled x, and r^n is labeled s.

3 This expression is the same as the one used in Boadway, Bruce, and Mintz (1984).

4 For an exposition of the neoclassical investment model see, for example, Ott, Ott, and Yoo (1975), Chapter 5.

5 F_k is really pf_k/q where f_k is the marginal physical product of capital. The price of capital, q, is constant and set equal to 1.

2 THE MODEL

The model used is similar to the one used by Boadway, Bruce, McKenzie and Mintz (1986) for the mining sector, but it distinguishes between the development and exploration stages.

1. Exploration stage: The firm uses current inputs, L, to locate oil fields. Current inputs are used to produce a flow of discoveries, adding to the stock of discoveries.

2. Depletable assets: Once the field is localized, the decision whether to develop has to be taken. Two factors have to be considered when making such a decision: the cost of finance and the expected rate of change of the price of the resource. These two components form the opportunity cost of holding the resource in the ground.

3. Development stage: The firm uses a stage-specific type of capital stock, K_d, to develop previously discovered oil fields.

4. Extraction stage: The firm uses a stage-specific capital stock, K_o, to extract oil from the previously developed oil fields.

The firm's cash flow is income from selling crude (pQ) plus the change in outstanding debt ($\dot{B}$) minus the following expenses:

a. exploration costs: wL where w is the wage rate of the labour inputs, L, used.

b. gross investment undertaken at the development stage: $\dot{K}_d + \delta_d K_d$ where $\dot{K}_d$ is the change in capital stock, δ_d is the depreciation rate attached to stage-specific capital, and K_d is undepreciated capital for tax purposes.

c. gross investment undertaken at the extraction stage: $\dot{K}_o + \delta_o K_o$.

d. federal and provincial taxes: T_F and T_p.

e. interest payments on debt outstanding: iB where i is the nominal rate of interest.

The goal of the firm is then to maximize the present value of dividends paid to its shareholders after taxes. It is assumed that the firm distributes its cash-flow as dividends to its shareholders.

$$D = pQ - wL - (\dot{K}_d + \delta_d K_d) - (\dot{K}_o + \delta_o K_o) - T_p - T_F - iB + \dot{B} \qquad (3)$$

Expression (3) when compounded over time and combined with the assumption of capital market equilibrium allows us to derive an expression for the real cost of finance (r^t) which is also the discount rate used by the firm to determine its present value. It is also assumed that the debt-equity ratio of the firm is exogenous and equal to the industry's average.[1] This enables us to express the change in debt and interest payments as a proportion of the present value of the firm.

We assume throughout this study that firms are in a taxable position, meaning that they can take full advantage of the tax credits and exemptions to which they are entitled.[2]

The discount rate is:[3]

$$r^t = \frac{\{\rho + (1-\theta)\ [1-U_F\ (1-\gamma) - U_p\ (1-\gamma)]\ i\beta\}}{\{(1-c) + (1-\theta)\ \beta\}} \qquad (4)$$

where:

U_F : federal corporate tax rate,

U_p : provincial corporate tax rate,

γ : depletion allowance.

Since $(1-c) + (1-\theta)\beta$ is exogenous, the firm's problem can be conceptualized as maximizing the present value of the stream of its cash flow discounted at the rate $r^t-\pi$ (or equivalently, maximizing the value of the dividends paid to shareholders) subject to four constraints. First, the amount of oil fields developed, over the firm's lifetime, does not exceed the amount of fields explored. Second, the amount of oil fields extracted, over the firm's lifetime, does not exceed the amount of fields developed. Third, gross investment (net of subsidies) at the development stage does not exceed the firm's book value at that stage. Fourth, gross investment (net of subsidies) at the exploration stage does not exceed the firm's book value at that stage. The first order conditions of this maximization problem provide us with expressions for the before-tax rates-of-return to capital for each production stage considered. They are:

- At the exploration stage:

$$r^g = \frac{[1-U_F(1-\gamma) - PIP - U_p(1-\gamma)]\ w}{a} \qquad (5)$$

The cost to the firm of a marginal unit of input at the exploration stage is reduced by the depletion allowance (γ). This expression is further reduced by Petroleum Incentive Payments received (PIP) and increased by taxes levied on profits (a).[4]

$$a = [1-U_F\ (1-\gamma)(1-g) - U_p\ (1-g)(1-\gamma) - g]$$

before 1974, (5a)

$$a = [1-U_F\ (1-\gamma)(1-\phi) - \Omega\ (1-\phi) - U_p\ (1-\gamma)\ (1-\phi_{gr}\ (g-\phi) - g) - (1-\phi_{gc})\ g]$$

after 1974, (5b)

$$z = [1-U_F\ (1-\gamma)(1-\phi) - \Omega\ \phi - U_p\ (1-\gamma+\phi_{gr}\ \phi)]$$

for the whole period. (5c)

- At the depletable asset stage:

$$r^g = [(r-\pi)\ (a/z)] + (1 - a/z)\ \dot{p}/p \qquad (6)$$

In a world without taxes, the rate of change of the price of a resource (the return from holding the resource in the ground) equals the real cost of finance facing the firm (the opportunity cost of holding the resource). This is the Hotelling rule (Hotelling, 1931). When we introduce taxes in the model, this is not the case anymore since both expressions are affected by taxes.

- At the development stage:

$$r^g = \frac{(1-\phi-PIP)\ (r+\delta_d-\pi)\ \left(1-\frac{[U_F(1-\gamma)+U_p(1-\gamma)]\ \alpha_d}{r+\alpha_d}\right)}{a} - \delta_d \qquad (7)$$

The user cost of development capital is the real cost of finance plus economic depreciation, minus the investment tax credit and the Petroleum Incentive Payments, minus several allowances provided by the tax system. We then adjust this expression for taxes levied (a). Since the capital used at this stage is not treated as a current expense, economic depreciation (δ_d) has to be taken into account.

- At the extraction stage:

$$r^g = \frac{(1-\phi)(r+\delta_o-\pi)\quad 1-\left[\frac{[U_F(1-\gamma)(1-\phi)-Q\phi\ +\ U_p(1-\gamma+\phi_{gr}\phi)]\alpha_o}{r+\alpha_o}\right]}{a} - \delta_o \qquad (8)$$

The expression for the before-tax real rate-of-return to capital used at the extraction stage is similar to the one obtained at the development stage, except to the extent that fiscal treatment of capital varies between the two stages.

The before-tax real rates of return for the four stages will be measured. Then, we will use them to compute marginal effective corporate tax rates ($r^g - r^t$). For depletable assets, development capital, and exploration capital these corporate tax rates will be combined with personal tax rates ($r^t - r^n$) to generate total tax rates. However, at the exploration stage, we will not compute total tax rates.[5] We will present only the before-tax real rates of return (r^g) and corporate tax rates (r^g-w) for that stage. Before turning to our empirical findings, a brief overview of the fiscal treatment facing the Alberta oil industry is presented in the next chapter.

Notes

1 Boadway (1985) relaxes that hypothesis. Gaynon, Suret, and St-Pierre (1986) show that tax variables have a very small impact on the financial decisions of the firms, thereby validating our assumption of exogenous debt-equity ratios in this analysis.

2 However, a significant proportion of firms (thirty to fifty per cent) will not be taxable in a given year (Jenkins, 1986).

3 This equation is derived in Appendix 1.

4 These equations are derived and the symbols used are defined in Appendix 1.

5 This is so because the opportunity cost of labour services, w, cannot be observed accurately.

3 DESCRIPTION OF THE FISCAL CONTEXT

Profits originating in the resource sector are subject to three types of taxes. First, a federal income tax is levied. Second, taxable income is subject to provincial income tax. And third, the province imposes royalties in order to capture economic rent. The total burden facing firms is given by the sum of all three types of taxes.

A. Federal Measures

The net federal income tax rate is 36 per cent, but the resource allowance reduces it to 27 per cent. Prior to 1974, provincial royalties were deductible when computing taxable income at the federal level. The resource allowance was introduced by the federal government to offset the non-deductibility of royalties for federal income tax purposes. It is a deduction of 25 per cent of resource profits before allowances for exploration and development expenses, earned depletion, and interest deduction.

An earned depletion allowance could be claimed for federal income tax purposes until 1981. Companies were allowed to deduct up to 25 per cent of net income. Depletion, though, had to be earned. Thirty-three and one-third per cent of eligible costs could be claimed.

Capital cost allowances that can be claimed are defined for specific types of capital, some of which are particular to the resource industry. Rates applicable vary between 30 and 100 per cent. The Investment Tax Credit can also be claimed at rates which vary between 7 and 10 per cent depending in which capital cost allowance class the investment undertaken falls and on its location.

The National Energy Program (NEP) was introduced along with the federal budget on October 28, 1980. It had three stated objectives: security of supply, Canadianization of the industry, and fairness in price setting and revenue assignment. The NEP was followed by the Ottawa-Alberta agreement ratified on September 1, 1981 which modified the price and tax environment the oil and gas industry was going to operate in.

To achieve the stated objectives of the NEP, the federal government introduced many new fiscal instruments: the Petroleum and Gas Revenue Tax (PGRT), the Natural Gas and Gas Liquids Tax (NGGLT), the Incremental Oil Revenue Tax (IORT), the Petroleum Compensation Charge (PCC), and the Canadian Ownership Special Charge (PCSC). Also worth noting was the replacement of depletion allowances by Petroleum Incentive Payments (PIPs) to encourage exploration.

The PGRT was initially set at 8 per cent of oil and gas net production revenue, not net income. It was set at 16 per cent with a 25 per cent resource allowance for an effective rate of 12 per cent in September 1981.

PIP grants were introduced to replace depletion allowances that were being phased out. The amount of subsidy to be received by a particular firm depended upon its Canadian ownership rate and control status (COR/CS), its geographic location (Canada lands versus Provincial lands), and the type of investment undertaken (exploration, development, and non-conventional). The rates varied between 0 and 80 per cent of expenses incurred.

The Western Accord signed in March 1985 by Ottawa and the three Western oil-producing provinces (British Columbia, Alberta, and Saskatchewan) and the new frontier energy policy of October 30, 1985 dismantled most of the taxes and incentives introduced under the NEP.

The two measures provided for the phasing-out of the PGRT by January 1, 1989. PIP grants have been terminated by March 1986 with outstanding commitments being grandfathered until the end of 1987. They are replaced by a royalty credit of 25 per cent of exploration costs (equal to or below $5 million per well) incurred in the frontier regions that can be claimed against royalties

otherwise payable in the region and a partially (at 40 per cent) refundable 25 per cent Exploration Tax Credit applicable across Canada to exploration expenses in excess of $5 million per well. Also eliminated were the NGGLT, the COSC, and the oil and gas export taxes. The IORT had already been repealed by January 1, 1985.

B. Provincial Measures

The provincial corporation income tax is levied on the same base as the federal corporation income tax. The provincial tax rate was fixed at 9 per cent and progressively increased to 11 per cent.

Provincial royalties of 12.5 to 16.7 per cent of the value of production of oil and gas were collected by the province in the 1960s and the early 1970s.

Then, in 1973, the first oil price shock occurred. The Organization of Petroleum Exporting Countries (OPEC) had existed for some time before it was able to exploit its market power effectively. Oil, which had been marketed until then at $4 a barrel, quadrupled in price. Reaction by the producing provinces was immediate. They scrapped existing royalty arrangements and imposed sliding-scale royalties on January 1, 1975, which resulted

in marginal royalties of 40 to 50 per cent for old oil and 30 to 40 per cent for new oil, in order to capture the economic rent created by this price increase. Average royalty rates have been around 22 per cent since then. A distinction was introduced between old oil (oil extracted from wells discovered before 1974) and new oil. The federal government responded by making royalties non-deductible for federal corporate tax purposes. The above resulted in a sharp decrease in producer profits and threats of capital flight started to emerge. The federal government compromised by establishing a resource allowance, allowing firms to deduct 25 per cent of their total income minus current costs and capital cost allowances.

At the same time, the Alberta government introduced a refundable Royalty Tax Credit which entitled companies to a credit for provincial corporate tax purposes equal to a proportion of provincial royalties paid, up to a maximum. In 1975, the Alberta government introduced a Royalty Tax Rebate, allowing a deduction for corporate tax purposes of the difference between the resource allowance claimed and the disallowed Crown royalty. In cases where the resource allowance was greater than royalties paid, no credit was to be granted, nor was such excess to be taxed.

4 EMPIRICAL RESULTS

A. Exploration Stage

Table 4-1 presents before-tax rates-of-return to capital and marginal effective corporate tax rates[1] that have been calculated for the period 1965-84 with and without royalties along with average figures.

Table 4-2 shows the values of the same variables for companies with a high Canadian ownership rate for the period 1981-1984. Firms falling in this category were subject to the same taxes as foreign-owned firms but were eligible for PIP grants while foreign firms were not.[2]

Let us first look at the situation in which royalties are excluded. The undertaking of exploration activity has been subsidized, at the margin, over the whole period 1965-1984 and because the model used to generate these numbers does not include the Exploratory Drilling Incentives Plan[3] created by the Alberta government, our results presumably overestimate the tax burden falling on the oil industry.

Table 4-1

Before-tax Rates-of-Return (r^g) and Tax Rates (r^g-w) at the Exploration Stage, With and Without Royalties,[1] 1965-84

Low Canadian Ownership Rate

Year	With Royalties				Without Royalties[2]	
	r^g (%)		r^g-w (%)		r^g (%)	r^g-w (%)
	old oil	new[3] oil	old oil	new oil		
1965	4.50		-5.73		2.75	-7.48
1966	4.50		-6.45		2.75	-8.21
1967	4.45		-6.98		2.73	-8.71
1968	4.02		-7.48		2.59	-8.91
1969	3.94		-8.60		2.55	-9.95
1970	3.86		-8.44		2.52	-9.78
1971	4.93		-5.48		2.86	-7.55
1972	5.71		-5.68		2.65	-8.74
1973	6.01		-6.34		2.70	-9.64
1974	37.28		24.36		3.23	-9.69
1975	n.a.	37.28	n.a.	24.36	3.37	-9.14
1976	n.a.	37.28	n.a.	24.36	2.86	-8.87
1977	n.a.	37.28	n.a.	24.36	2.86	-9.33
1978	n.a.	37.28	n.a.	24.36	2.86	-9.63
1979	n.a.	37.28	n.a.	24.36	2.86	-11.25
1980	n.a	5.25	n.a.	-9.22	2.61	-11.86
1981	n.a.	7.80	n.a.	-8.99	3.04	-13.75
1982	9.37	5.25	-4.86	-8.80	3.99	-10.00
1983	4.23	3.50	-6.88	-7.62	2.98	-8.14
1984	4.65	3.60	-7.38	-8.43	3.17	-8.87
Average 1965-84	7.50	14.55	-4.30	2.10	2.90	-9.48

1 The distinction between old and new oil appears only when royalties are included since other taxes do not discriminate between old and new oil.

2 When there are no royalties paid, no resource allowance may be claimed.

3 New oil is the oil extracted from wells discovered after 1974.

Table 4-2

Before-tax Rates-of-Return (r^g) and Tax Rates (r^{g-w}) at the Exploration Stage, With and Without Royalties, 1981-84

High Canadian Ownership Rate

Year	With Royalties				Without Royalties	
	r^g (%)		r^{g-w} (%)		r^g (%)	r^{g-w} (%)
	old oil	new oil	old oil	new oil		
1981	1.85	1.61	-14.94	-15.19	1.41	-15.38
1982	1.60	1.51	-12.45	-12.54	1.46	-12.55
1983	1.25	1.23	-9.80	-9.82	1.21	-9.91
1984	1.17	1.16	-10.87	-10.88	1.15	-10.85
Average 1965-84	6.07	13.82	-6.09	1.37	2.50	-9.87

There are two breaks in the series. First, the required before-tax rates-of-return increase[4] in 1974 and 1975 as well as in 1981 rates-of-return increase for firms with a low Canadian ownership rate. This latter increase is due to the NEP. Conversely, they decrease for firms with a high Canadian ownership rate showing that PIP grants more than offset the effect of PGRT for these firms.

When royalties are included in the analysis, a severe break in the series occurs in 1974 with the end of the deductibility of royalties for federal income tax purposes.

In 1981, the required rate-of-return on both new and old oil increased for firms with low Canadian ownership rate due to the implementation of PGRT. However, this was not the case for firms with a high Canadian ownership rate because of PIP grants.

The average figures presented at the bottom of Tables 4-1 and 4-2 show that exploration capital has been subsidized at the margin by corporate income tax during the whole period, whether or not royalties were included.

B. Depletable Asset Stage

Tables 4-3 and 4-4 show both after-tax rates-of-return to savers and before-tax rates of return to capital over the period 1965-84

without and with royalties. Corporate, personal, and total marginal effective tax rates are also presented.

Let us first look at Table 4-3 wherein the rates shown exclude royalties. Corporate tax rates were negative throughout the whole period becoming even more so in 1974 and 1975 with the decrease in federal corporate tax rate and the increase in the price of oil. Personal tax rates, on the other hand, are positive and nearly equal, in absolute terms, to corporate tax rates. Total tax rates, therefore, are very close to zero averaging 0,42 per cent over the period.

Royalties are the only fiscal provision treating revenues and costs in an asymmetrical fashion. Therefore, their absence results in the expression for the gross rates of return on depletable assets being a classical Hotelling rule-type expression -- i.e., the gross rate of return on depletable assets is equal to the real opportunity cost of finance. The only tax distortions remaining in this case are thus the ones already summarized in the market discount rate.[5]

Table 4-4 shows the figures including royalties. The general pattern is the same. However, the non-deductibility of royalties for federal income tax purposes in 1974, the introduction of provincial royalty credits and rebates in 1975, and the

Table 4-3

Tax Rates for the Depletable Assets without Royalties, 1965-84

Year	r^t	r^n	r^g	r^g-r^t	r^t-r^n	r^g-r^n
1965	10.05	6.52	8.25	-1.80	3.53	1.73
1966	10.74	6.53	8.04	-2.70	4.21	1.51
1967	11.26	5.32	7.06	-4.20	5.94	1.74
1968	11.20	7.54	7.90	-3.30	3.66	0.36
1969	12.23	8.04	8.33	-3.90	4.19	0.29
1970	12.03	7.23	7.43	-4.60	4.80	0.20
1971	10.20	7.54	8.00	-2.20	2.66	0.46
1972	12.24	7.17	9.74	-2.50	5.07	2.57
1973	12.80	5.07	7.30	-5.50	7.73	2.23
1974	12.42	3.32	4.12	-8.30	9.10	0.80
1975	12.71	0.96	1.11	-11.60	11.75	0.15
1976	11.44	3.54	1.94	-9.50	7.90	-1.60
1977	12.20	7.51	7.60	-4.60	4.69	0.09
1978	12.83	5.71	5.43	-7.40	7.12	-0.28
1979	15.61	6.29	7.01	-8.60	9.32	0.72
1980	16.05	8.99	7.95	-8.10	7.06	-1.04
1981	15.39	8.02	7.88	-7.51	7.37	-0.14
1982	13.19	5.43	7.49	-5.70	7.76	2.06
1983	12.67	5.78	8.61	-4.06	6.89	2.82
1984	12.05	12.47	6.21	-5.84	-0.42	-6.26
Average 1965-84	12.47	6.45	6.87	-5.60	6.02	0.42

differentiated treatment of old and new oil created variations in tax rates.

The contribution of royalties to the overall fiscal burden borne by capital at this stage is quite small. This suggests that even if, theoretically, royalties distort the decision as to whether a firm should develop a previously localized oil field, it is not very important in practice.

The effect of taxes at this stage is twofold. First, their presence increases the cost of finance. Second, it decreases the expected return from selling the resource. The two forces offset each other so that their combined effect on the user cost of capital is negligible.

C. Development Stage

Several types of capital used at the development stage have been examined. Whether capital consists of machinery and equipment or engineering and construction and whether it is used in Northern or Southern Alberta has been taken into account. The results analyzed in this section pertain to capital in the form of machinery and equipment used in Northern Alberta. The interested reader will find results for all other types of capital in Appendix 3.

Table 4-4

Tax Rates for Depletable Assets with Royalties, 1965-1984

Year	r^t	r^n	r^g		$r^g - r^t$		$r^t - r^n$	$r^g - r^n$	
			OLD	NEW	OLD	NEW		OLD	NEW
1965	10.05	6.52	6.69		-3.36		3.53	0.17	
1966	10.74	6.53	6.53		-4.21		4.21	0.00	
1967	11.26	5.32	5.43		-5.83		5.94	0.11	
1968	11.20	7.54	6.40		-4.80		3.66	-1.14	
1969	12.23	8.04	6.01		-5.36		4.19	-2.03	
1970	12.03	7.23	6.49		-5.17		4.80	-0.74	
1971	10.20	7.54	8.32		-1.98		2.66	0.68	
1972	12.24	7.17	7.28		-4.96		5.07	0.11	
1973	12.80	5.07	10.27		-2.53		7.73	5.20	
1974	12.42	3.32	16.38		-1.36		9.10	13.06	
1975	12.71	0.96	13.40	7.96	0.69	-4.75	11.75	12.44	7.00
1976	11.44	3.54	10.74	7.25	-0.70	-4.19	7.90	7.20	3.71
1977	12.20	7.51	13.75	11.44	1.55	-0.76	4.69	6.24	3.93
1978	12.83	5.71	12.60	10.13	-0.23	-2.70	7.12	6.89	4.42
1979	15.61	6.29	7.27	7.18	-8.34	-8.43	9.32	0.98	0.89
1980	16.05	8.99	11.15	10.06	-4.90	-5.99	7.06	2.16	1.07
1981	15.39	8.02	12.45	10.67	-2.94	-4.72	7.37	4.43	2.65
1982	13.19	5.43	10.53	8.72	-2.66	-4.47	7.76	5.10	3.29
1983	12.67	5.78	9.69	9.08	-2.98	-3.59	6.89	3.91	3.30
1984	12.05	12.47	5.42	5.89	-6.63	-6.16	-0.42	-7.05	-6.58
Average 1965-84	12.47	6.45	9.34	8.41	-3.33	-4.09	6.02	2.89	1.95

Table 4-5 shows rates-of-return, corporate, personal, and total tax rates with royalties excluded for 1964-85. Table 4-6 shows figures including royalties.

Capital used at the development stage has been subsidized, at the margin, by the corporate tax system (excluding royalties) over the whole period considered. Required rates-of-return began to decrease in 1974 and the two first years in which the required rates-of-return became negative are 1975 and 1976. The federal corporate tax rate was lowered and the federal Investment Tax Credit was introduced in 1975. The most important change in 1974-76 has been an increase in the expected inflation rate coupled with a decrease in the nominal cost of finance.

Turning to Table 4-6, which includes royalties, we see that these changes have more than offset the non-deductibility of royalties for federal corporate tax purposes in 1974 and have reinforced the impact of the introduction of the federal Investment Tax Credit and various provincial programs in 1975-76. The National Energy Program did not have much impact on corporate tax rates because it has been overpowered by the increase in expected inflation and the decrease in the nominal cost of finance. Royalties, on the other hand, had a significant impact on tax rates, especially for old oil over the period 1975-81.

Table 4-5

Tax Rates for the Development Stage without Royalties, Machinery in Northern Alberta, 1965-84

Low Canadian Ownership Rate

Year	r^t	r^n	r^g	r^g-r^t	r^t-r^n	r^g-r^n
1965	10.24	6.52	5.78	-4.46	3.72	-0.74
1966	10.96	6.53	5.70	-5.26	4.43	-0.83
1967	11.44	5.32	4.62	-6.82	6.12	-0.70
1968	11.50	7.54	5.50	-6.00	3.96	-2.04
1969	12.54	8.04	6.14	-6.40	4.50	-1.90
1970	12.20	7.23	4.98	-7.32	5.07	-2.25
1971	10.41	7.54	5.78	-4.63	2.87	-1.76
1972	11.39	7.17	6.42	-4.97	4.22	-0.75
1973	12.34	5.07	4.30	-8.04	7.27	-0.77
1974	12.92	3.32	2.51	-10.41	9.60	-0.81
1975	12.51	0.96	-2.08	-14.59	11.55	-3.04
1976	11.73	3.54	-1.46	-13.19	8.19	-5.00
1977	12.19	7.51	3.85	-8.34	4.68	-3.66
1978	12.48	5.71	1.26	-11.22	6.77	-4.45
1979	14.10	6.29	1.43	-12.67	7.81	-4.86
1980	14,47	8.99	1.97	-12.50	5.48	-17.02
1981	15.75	8.02	3.42	-12.34	7.73	-4.60
1982	13.49	5.43	-0.96	-14.45	8.06	-6.39
1983	10.79	5.78	-0.24	-11.03	5.01	-6.02
1984	12.04	12.47	15.97	3.93	-0.43	3.50
Average 1965-84	12.28	6.45	3.74	-8.54	5.83	-2.70

Table 4-6

Tax Rates for the Development Stage with Royalties, Machinery in Northern Alberta, 1965-84

Low Canadian Ownership Rate

Year	r^t	r^n	r^g		r^g-r^t		r^t-r^n	r^g-r^n	
			OLD	NEW	OLD	NEW		OLD	NEW
1965	10.24	6.52	10.40		0.16		3.72	3.88	
1966	10.96	6.53	10.30		-0.66		4.43	3.77	
1967	11.44	5.32	9.02		-2.42		6.12	3.70	
1968	11.50	7.54	10.22		-1.28		3.96	2.68	
1969	12.54	8.04	11.06		-1.48		4.50	3.02	
1970	12.30	7.23	9.68		-2.63		5.07	2.44	
1971	10.41	7.54	10.38		-0.02		2.87	2.85	
1972	11.39	7.17	13.40		2.01		4.22	6.23	
1973	12.34	5.07	10.53		-1.81		7.27	5.46	
1974	12.92	3.32	8.60		-4.32		9.60	5.28	
1975	12.51	0.96	11.39	2.83	-1.12	-9.37	11.55	10.43	2.18
1976	11.73	3.54	15.18	5.11	3.45	-6.62	8.19	11.64	1.57
1977	12.19	7.51	24.96	12.62	12.78	0.44	4.68	17.46	5.12
1978	12.48	5.71	18.83	9.31	6.35	-3.18	6.77	13.12	3.59
1979	14.10	6.29	18.47	9.19	4.37	-4.91	7.81	9.28	2.90
1980	14.47	8.99	10.68	6.70	-3.79	-7.77	5.48	1.69	-2.29
1981	15.75	8.02	22.40	11.64	6.64	-4.12	7.73	1.09	3.61
1982	13.49	5.43	2.85	0.46	-10.65	-13.04	8.06	-2.59	-4.98
1983	10.79	5.78	2.76	1.00	-8.02	-9.79	5.01	-2.99	-4.78
1984	12.04	12.47	18.61	15.54	6.57	3.50	-0.43	6.14	3.07
Average 1965-84	12.28	6.45	12.49	8.90	4.13	-3.36	5.83	5.23	2.46

Table 4-7

Tax Rates for the Development Stage without Royalties, Machinery in Northern Alberta, 1981-84

High Canadian Ownership Rate

Year	r^t	r^n	r^g	r^g-r^t	r^t-r^n	r^g-r^n
1981	15.75	8.02	-1.97	-17.72	7.73	-9.99
1982	13.49	5.43	-4.94	-18.43	8.06	-10.37
1983	10.79	5.78	-5.35	-16.14	5.01	-11.13
1984	12.04	12.47	7.26	-4.78	-0.43	-5.21
Average 1965-84	12.28	6.45	2.59	-9.70	5.83	-3.86

Table 4-8

Tax Rates for the Development Stage with Royalties, Machinery in Northern Alberta, 1981-84

High Canadian Ownership Rate

Year	r^t	r^n	r^g		$r^g - r^t$		$r^t - r^n$	$r^g - r^n$	
			OLD	NEW	OLD	NEW		OLD	NEW
1981	15.75	8.02	13.45	5.08	-2.31	-10.68	7.73	5.52	-2.95
1982	13.49	5.43	-1.63	-3.49	-15.12	-16.98	8.06	-7.06	-8.92
1983	10.79	5.78	-2.26	-3.63	-13.05	-14.42	5.01	8.04	-9.41
1984	12.04	12.47	10.04	7.66	-1.99	-4.38	-0.43	-2.42	-4.81
Average 1965-84	12.88	6.45	11.13	7.75	2.78	-5.42	5.80	4.08	1.44

When personal tax rates are added to corporate tax rates, the results show that capital used at the development stage is, at the margin, slightly subsidized when royalties are excluded and slightly taxed when royalties are included. Total figures are close to zero in both cases.

Tables 4-7 and 4-8 show tax rates facing firms with a high Canadian ownership rate for 1981 to 1984. Table 4-7 shows these rates excluding royalties while Table 4-8 includes them.

Firms with a high Canadian ownership rate faced lower tax rates than foreign-owned firms in 1981-84 since they were eligible for PIP grants. Appendix 3 shows the results for firms with average Canadian property rates.

D. Extraction Stage

Tables 4-9 and 4-10 show tax rates for capital at the extraction stage, excluding and including royalties, respectively. At the margin, the corporate tax system subsidized capital used at that stage over the period 1965-84. However, when royalties are included, the tax system taxed capital at that stage.

The same breaks in the series occur here as at the development stage. Capital is slightly more subsidized at the development

Table 4-9

Tax Rates for the Extraction Stage without Royalties, Machinery in Northern Alberta, 1965-84

Year	r^t	r^n	r^g	r^g-r^t	r^t-r^n	r^g-r^n
1965	10.05	6.52	2.83	-7.22	3.53	-3.69
1966	10.74	6.53	2.80	-7.94	4.21	-3.73
1967	11.26	5.32	1.72	-9.54	5.94	-3.60
1968	11.20	7.54	2.10	-9.09	3.66	-5.44
1969	12.23	8.04	2.92	-9.30	4.19	-5.12
1970	12.03	7.23	1.55	-10.48	4.80	-5.68
1971	10.20	7.54	3.18	-7.02	2.66	-4.36
1972	11.19	7.17	3.57	-7.62	4.02	-3.60
1973	12.09	5.07	1.35	-10.74	7.02	-3.72
1974	12.56	3.32	0.24	-12.32	9.24	-3.08
1975	12.14	0.96	-4.53	-16.68	11.18	-5.49
1976	11.16	3.54	-5.13	-16.29	7.62	-8.67
1977	11.77	7.51	0.99	-10.79	4.26	-6.52
1978	12.01	5.71	-1.93	-13.94	6.30	-7.64
1979	13.52	6.29	-1.75	-15.26	7.23	-8.04
1980	13.67	8.99	-2.06	-15.74	4.68	-11.05
1981	15.75	8.02	3.42	-12.34	7.73	-4.60
1982	13.49	5.43	-0.96	-14.45	8.06	-6.39
1983	10.79	5.78	-0.24	-11.02	5.01	-6.02
1984	12.04	12.47	15.97	3.93	-0.43	3.50
Average 1965-84	11.99	6.45	1.30	-10.69	5.55	-5.15

Table 4-10

Tax Rates for the Extraction Stage with Royalties, Machinery in Northern Alberta, 1965-84

Year	r^t	r^n	r^g		$r^g - r^t$		$r^t - r^n$	$r^g - r^n$	
			OLD	NEW	OLD	NEW		OLD	NEW
1965	10.05	6.52	8.43		-1.63		3.53	1.90	
1966	10.74	6.53	8.39		-2.36		4.21	1.85	
1967	11.26	5.32	7.15		-4.11		5.94	1.83	
1968	11.20	7.54	8.03		-3.17		3.66	0.49	
1969	12.23	8.04	9.20		-3.03		4.19	1.16	
1970	12.03	7.23	7.61		-4.42		4.80	0.38	
1971	10.20	7.54	8.73		-1.46		2.66	1.20	
1972	11.19	7.17	12.42		1.22		4.02	5.24	
1973	12.09	5.07	9.19		-2.90		7.02	4.12	
1974	12.56	3.32	6.31		-6.25		9.24	2.99	
1975	12.14	0.96	24.21	3.20	12.07	-8.95	11.18	23.25	-0.78
1976	11.16	3.54	52.51	7.93	41.35	-3.23	7.62	48.97	-0.71
1977	11.77	7.51	71.25	19.86	59.47	8.08	4.26	63.73	5.19
1978	12.01	5.71	53.46	14.18	41.45	2.17	6.30	47.75	2.45
1979	13.52	6.29	50.12	15.46	36.61	1.94	7.23	43.84	2.88
1980	13.67	8.99	19.86	8.30	6.19	-5.37	4.68	10.87	-5.31
1981	15.75	8.02	47.76	21.48	32.01	5.73	7.73	39.74	4.88
1982	13.49	5.43	8.31	4.13	-5.18	-9.37	8.06	-2.88	-5.18
1983	10.79	5.78	14.29	9.67	3.50	-1.11	5.01	8.51	-2.81
1984	12.04	12.47	41.75	33.47	29.71	21.43	-0.43	29.28	9.21
Average 1965-84	11.99	6.45	23.45	11.57	11.45	-0.73	5.55	17.00	5.12

than at the extraction stage because at the latter it does not get either resource or depletion allowances while at the former it does. In the cases in which royalties are excluded, the tax rates are the same for both stages from 1981 on because of the elimination of earned depletion at the development stage.

When personal taxes are included, the total tax rates are negative when royalties are excluded, around 5 per cent for new oil when royalties are included, and 17 per cent for old oil when royalties are included.

Notes

1 As we mentioned earlier, we cannot compute total marginal effective tax rates for the input used at the exploration stage since the only input used is labour.

2 Results for 1981-84 for firms with average Canadian ownership rates are presented in Appendix 3.

3 For a description of this program which provides tax relief differentiated by area and well depth, see Foat and MacFadyen; 1983, p. 85.

4 The variations in r^g at the exploration stage for 1974 and 1975 are artificial in the sense that they are created by the way we calculate r^g. They are due to changes in variables entering the calculation of the real cost of finance, namely the required rate-of-return to equity and the interest rate.

5 The user cost of capital expression for the depletable assets stage excluding royalties is equivalent to the one found in Boadway, Bruce, McKenzie and Mintz (1986) for the mining sector. However, when we include royalties the expression differs since royalties impact only on revenues, not on costs.

5 PROPERTY AND SALES TAXES

Presumably, property and sales taxes also impact on the magnitude of tax rates facing firms. This section attempts to integrate these two taxes into the model.

A. Sales Tax

Sales taxes on capital inputs are expressed as percentages of gross investment undertaken at each stage. They are modeled as increases in the cost of gross investment.[1] The rate for 1981[2] for machinery and equipment was 2.2 per cent.

The results show that the inclusion of sales taxes at the machinery and equipment level increase required rates-of-return by about 1 percentage point at the development stage. Corporate tax rates increase by about 2 percentage points.

Results are similar at the extraction level. Required rates-of-return increase by one-half of a percentage point for machinery and equipment. Corporate tax rates increase by about 1 percentage point. The impact of sales taxes on capital inputs is therefore non-negligible.

B. Property Tax

The property taxes have been included in the model for the period 1972-81. They are expressed as percentages of sales of goods.[3]

The results show a small impact on required rates-of-return and corporate tax rates. Depending on the stage considered, required rates-of-return increase by one-fourth to 1 percentage point, thereby increasing corporate tax rates by one-half to 2 percentage points.

Notes

1 Appendix 1 contains the details of the inclusion of both taxes in the model.

2 Data for sales tax come from dividing sales taxes paid by gross capital formation. (Statistics Canada, unpublished data).

3 Data for property taxes come from Glenn Jenkins's Socrat data base.

6 CONCLUSION

The goal of this paper was to measure marginal effective tax rates for the Alberta oil industry for the period 1965-84.

The results indicate that the corporation income tax has subsidized, at the margin, acquisition of capital at most production stages over the twenty year period considered. Royalties, on the other hand, have resulted in positive tax rates at the development and extraction stages for the second half of the 1970s. However, firms that are not eligible to the Alberta Royalty Tax Credit are taxed at the corporate level when they undertake new investments. Property and sales taxes have also contributed to increase tax rates. These two last types of taxes accounted for about 2 percentage points in the corporate tax rates.

Taxes on capital at the personal level have contributed positively to total marginal effective tax rates. Total tax rates have hovered around zero: the impact of the personal income tax offsetting that of the corporation income tax.

These results suggest that, at least for firms which could benefit from the Alberta Royalty Tax Credit, the marginal fiscal burden of the oil industry was not heavy. On the other hand, it has been found in a recent study[1] that the corporation income tax

has subsidized the holding of land and machinery but taxed buildings and inventories in the economy as a whole. A shift of capital from the non-resource sectors to the resource sector might have happened.

Two interesting extensions could be made to the model used in this paper. The first one would be to allow for the possibility of substitution between labour and capital inputs at each production stage. The second would be to include flow-through shares in the model. However, this latter improvement would imply modelling a firm that is in a non-taxable position for five years and then becomes taxable.

Notes

1 Boadway, Bruce, and Mintz, 1984.

APPENDIX 1

THE MODEL

A. General Model

The stream of dividends of the firm is:

$$(1)\quad D = pQ - wL - (\dot{K}_o + \delta_o K_o) - (\dot{K}_D + \delta_d K_d) - T_F - T_P - iB + \dot{B}$$

Tax liabilities can be expressed as:

- 1965-73

$$(2)\quad T_F = U_F\,(1 - \gamma)\,\{(1 - g)\,pQ - \alpha_o \hat{K}_o - \alpha_d \hat{K}_d - wL - iB\}$$

$$(3)\quad T_P = U_P\,\{pQ - \alpha_o \hat{K}_o - \alpha_d \hat{K}_d - wL - iB - gpQ\} + gpQ$$

- 1974

$$(2')\quad T_F = U_F\,(1 - \gamma)\,\{(1 - \phi)\,[pQ - \alpha_o \hat{K}_o] - iB - \alpha_d \hat{K}_d - wL\}$$

$$(3')\quad T_P = U_P\,\{pQ - \alpha_o \hat{K}_o - \alpha_d \hat{K}_d - wL - iB - gpQ - \gamma$$

$$(pQ - \alpha_o \hat{K}_o - \alpha_d \hat{K}_d - wL - gpQ)\} + (1 - \phi_{gc})\,gpQ$$

- 1975-80

$$(2'') \quad T_F = U_F\,(1-\gamma)\,\{(1-\phi)\,[pQ - \alpha_o\hat{K}_o] - iB - \alpha_d\hat{K}_d - wL\}$$

$$- \phi\,(\dot{K}_o + \delta_o K_o + \dot{K}_d + \delta_d K_d)$$

$$(3'') \quad T_P = U_P\,[pQ - \alpha_o\hat{K}_o - \alpha_d\hat{K}_d - wL - iB$$

$$- \gamma\,(pQ - \alpha_o\hat{K}_o - \alpha_d\hat{K}_d - wL - gpQ)$$

$$- \phi_{gR}\,(gpQ - \psi\,(pQ - \alpha_o\hat{K}_o))]$$

$$+ (1 - \phi_{gc})\,gpQ$$

- 1981-84

$$(2''') \quad T_F = U_F\,(1-\gamma)\,\{(1-\phi)\,[pQ - \alpha_o\hat{K}_o] - iB - \alpha_d\hat{K}_d - wL\}$$

$$+ Q\,[pQ - \psi\,(pQ - \alpha_o\hat{K}_o)] - (\phi + PIP)\,(\dot{K}_o + \delta_o K_o$$

$$+ \dot{K}_d + \delta_d K_d) - PIF\,wL$$

$$(3''') \quad T_P = U_P\,[pQ - \alpha_o\hat{K}_o - \alpha_d\hat{K}_d - wL - iB - \gamma\,(pQ - \alpha_o\hat{K}_o - \alpha_d\hat{K}_d$$

$$- wL - gpQ) - \phi_{gR}\,(gpQ - \psi\,(pQ - \alpha_o\hat{K}_o))]$$

$$+ (1 - \phi_{gc})\,gpQ$$

Substituting (2"') and (3"') into (1), rearranging, and multiplying by $e^{\pi t}$ -- where π is the expected inflation rate -- we get an expression for real dividends:

$$
\begin{aligned}
(4)\quad D = {} & e^{\pi t}pQ - e^{\pi t}wL - e^{\pi t}(\dot{K}_o + \delta_o K_o) - e^{\pi t}(\dot{K}_d + \delta_d K_d) \\
& - iB + \dot{B} - U_F(1-\gamma)\{(1-\phi)[e^{\pi t}pQ - \alpha_o \hat{K}_o] - iB - \alpha_d \hat{K}_d \\
& - wL\, e^{\pi t}\} - \Omega[e^{\pi t}pQ - \phi(e^{\pi t}pQ - \alpha_o \hat{K}_o)] \\
& + e^{\pi t}(\phi + PIP)(\dot{K}_o + \delta_o K_o + \dot{K}_d + \delta_d K_d) + e^{\pi t}PIPwL \\
& - U_p(1-\gamma)\left[\begin{array}{l} e^{\pi t}pQ - \alpha_o \hat{K}_o - \alpha_d \hat{K}_d - e^{\pi t}wL - iB \\ \quad - \phi_{gR}\left[e^{\pi t}gpQ - \phi[e^{\pi t}pQ - \alpha_o K_o]\right] \\ \quad - (1-\phi_{gc})e^{\pi t}gpQ \end{array}\right]
\end{aligned}
$$

Assuming capital markets are in equilibrium and the debt-equity ratio of the firm is exogenous and constant over time, the problem of the firm can be restated as maximizing the present value of dividends discounted at the real cost of finance ($r^t - \pi$) -- equation (5).

The problem is thus to maximize:[1]

$$(5)\quad \int_o^{\infty} e^{-(r^t-\pi)t}\Big[[1 - U_F\,(1-\gamma)\,(1-\phi) - \Omega\,(1-\phi)$$

$$- U_P\,(1-\gamma)\,(1 - \phi_{gR}\,(g-\phi))$$

$$- (1 - \phi_{gc})\,g]\,pQ$$

$$- (1 - \phi - PIP)\,(\dot{K}_o + \delta_o K_o + \dot{K}_d + \delta_d K_d)$$

$$- [1 - U_F\,(1-\gamma) - U_P\,(1-\gamma) - PIP]\,wL$$

$$+ [U_F\,(1-\gamma)\,(1-\phi) + \Omega\,\phi + U_P\,(1-\gamma) + U_P\,\phi_{gR}\,\phi]\,\alpha_o \hat{K}_o$$

$$+ [U_F\,(1-\gamma) + U_P\,(1-\gamma)]\,\alpha_d \hat{K}_d\Big]dt$$

$$\text{Where } r^t = \frac{\rho + (1-\theta)[1-U_F(1-\gamma) - U_P(1-\gamma)]i\beta}{(1-c) + (1-\theta)\beta}$$

The nominal cost of finance, r^t, is a weighted average of the cost of debt and of equity, adjusted for taxes. Note that r^t is not exogenously fixed as in King and Fullerton (1984) or Daly et al (1985).

subject to two accounting constraints:

$$(6)\quad \dot{K}_o + \alpha_o \hat{K}_o = (1 - \phi - PIP)\, e^{\pi t}\, (\dot{K}_o + \delta_o K_o)$$

$$(6a)\quad \dot{K}_d + \alpha_d \hat{K}_d = (1 - \phi - PIP)\, e^{\pi t}\, (\dot{K}_d + \delta_d K_d)$$

and to two physical constraints:

$$(7)\quad \int_o^t [Q - X(K_o, K_d, F)]\, dt = 0$$

$$(8)\quad \int_o^t [F - R(L)]\, dt = 0$$

The last constraint ensures that the total amount of resource developed over time equals the total amount of resource explored. The second-last constraint ensures that the amount of resource extracted over time equals the total amount developed.

The first-order conditions are:

$$(9)\quad \frac{\partial X}{\partial F}\frac{\partial R}{\partial L} = \frac{[1 - U_F\,(1 - \gamma) - PIP - U_p\,(1 - \gamma)]\, w}{a}$$

$$(10)\quad \frac{\dot{p}}{p} = (r - \pi)\,(a/z) + (1 - a/z)\,\dot{p}/p$$

$$(11)\quad \frac{\partial X}{\partial K_d} = \frac{(1-\phi-PIP)\,(r+\delta_d-\pi)\,\left[1 - \dfrac{(U_F(1-\gamma)+U_p(1-\gamma))}{r + \alpha_d}\,\alpha_d\right]}{a}$$

$$(12)\quad \frac{\partial X}{\partial K_o} = \frac{(1-\phi)(r+\delta_o-\pi)\left[1-\left(\left(U_F(1-\gamma)(1-\psi)-\Omega\psi+U_P(1-\gamma+\phi_{gR}\psi)\right)\alpha_o\right)/(r+\alpha_o)\right]}{a}$$

B. Inclusion of Sales Taxes

Sales taxes are expressed as percentages of gross investment; they therefore increase the cost of capital inputs. They are modeled as:

$$(13)\quad (1+S)(\dot{K}_o+\delta_o K_o)+(1+S)(\dot{K}_d+\delta_d K_d)$$

where S: sales tax rate

in the dividend expression (equation 1).

C. Inclusion of Property Taxes

Property taxes are expressed as proportions of the sales of goods. They therefore increase total taxes payable by a factor equal to $T_p \times PQ$ in equation 1 -- where T_p is the property tax rate. However, they are deductible for both provincial and federal corporate tax purposes: Equations 2 and 3 are modified accordingly.

Legend

$\dot{B}$ = change in debt outstanding

c = marginal personal tax rate on accrued capital gains

g = Crown royalty rate

iB = interest payments on debt

K_d = capital used at the development stage

$\hat{K}_d$ = undepreciated development capital for tax purposes

K_o = capital used at the extraction stage

$\hat{K}_o$ = undepreciated extraction capital for tax purposes

L = labour used at the exploration stage

p = wellhead price of oil

PIP = Petroleum Incentive Payments rate

Q = quantity of resource extracted

S = sales tax rate

U_F = federal corporate tax rate

U_P = provincial corporate tax rate

w = wage of labour at the exploration stage

α_d = Capital Cost Allowance on development capital

α_o = Capital Cost Allowance on extraction capital

γ = depletion allowance

δ_d = economic depreciation of development capital

δ_o = economic depreciation of extraction capital

ψ = resource allowance

θ = marginal personal tax rate on dividend income

ϕ = Investment Tax Credit rate

ϕ_{gc} = Alberta Royalty Tax Credit rate

ϕ_{gR} = Alberta Royalty Tax Rebate rate

Ω = Petroleum and Gas Revenue Tax rate

Note

1 The case presented is for 1981.

APPENDIX 2

THE DATA

A. Corporate Side

1. Federal and Provincial Corporate Tax Rates; U_F and U_P:

CCH, Canadian Master Tax Guide, various years.

2. Depletion Allowance; γ:

A depletion allowance rate of 33 1/3 per cent was automatic until 1973 inclusively, which means that the appropriate base for this fiscal parameter was the same as that of the corporate income tax. In 1974 the definition of the base for depletion allowance purposes was changed. It became the minimum of 25 per cent of resource profits (earned depletion) and 33 1/3 per cent of the corporate tax base (automatic depletion). The base considered for the purposes of this exercise is the automatic depletion one. The reason for doing so is that if earned depletion were a binding constraint, it would not affect the marginal investment decision of the firm and should not be considered in evaluating the cost of a marginal unit of capital. If it

were not binding, then the firm would be entitled to automatic depletion. The automatic depletion will affect the firm's decision since what is not allowed to be deducted now will be deducted in the following year. Therefore, at the period at which decisions are taken, the present value of the depletion allowance should be embodied in the cost of capital.

In the case of exploration capital, the depletion allowance has been decreasing since 1981. For development capital, it has been eliminated in 1981. And it has never applied at the depletable asset stage and to capital used at the extraction stage.

3. Resource Allowance; ϕ:

The Resource Allowance applies to gross resource income minus direct operating costs and capital cost allowances on capital. It had a value of 25 per cent throughout the considered period considered for capital used at all stages except extraction. The data came from CCH, Canadian Master Tax Guide, various years.

4. Capital Cost Allowance; α:

The main classes of capital used in this study are described in Holland, Schulli and Kemp (1979). Two classes are used. Class 10 contains all equipment and machinery used at the extraction stage. This class includes approximately 80 per cent of the total amount of capital expenses claimed by the petroleum industry and was entitled to a capital cost allowance of 30 per cent on a declining balance basis from 1966 to 1984. Class 28 contains all equipment and machinery used at the development stage and was entitled to a 30 per cent capital cost allowance on a declining balance basis from 1973 to 1984. These figures come from CCH, Canadian Master Tax Guide, various years.

5. Petroleum and Gas Revenue Tax; Ω:

This tax was part of the National Energy Program and was effective from 1981 to 1984. Its value was 8 per cent of gross revenue minus operating costs and the resource allowance in 1981; 16 per cent between January 1, 1982 and June 30, 1982; 14.67 per cent between June 30, 1982 and June 30, 1983; and 16 per cent from June 30, 1983 on. The data comes from Energy, Mines and Resources, "Chronology of Federal Upstream Fiscal Instruments: A Summary," July 1, 1985.

6. Investment Tax Credit; ϕ:

The federal Investment Tax Credit was introduced in 1975. Its rate varies across regions. In Alberta, a flat rate was used in 1975 and 1976 but, since then, different rates apply to Southern (7 per cent) and Northern Alberta (10 per cent). The data comes from CCH, Canadian Master Tax Guide, various years.

7. Petroleum Incentive Payments; PIP:

PIP grants were introduced by the National Energy Program in 1981. The rate of subsidy varies with levels of Canadian ownership and with the stage at which investment occurs. The appropriate figures come from the Department of Energy, Mines and Resources, Petroleum Fiscal System in Canada: A Summary, October 1983 and Energy, Mines and Resources, "Chronology of Federal Upstream Fiscal Instruments: A Summary," July 1, 1985.

8. Royalties on Oil Production; g:

From 1965 to 1972, royalties in Alberta were defined as a proportion of crude oil production. A maximum rate of 16.67 per cent prevailed. From 1972 to 1974, this rate was 22 per cent. Marginal royalties were equal to average ones.

From 1975 on royalties were expressed on a sliding-scale basis. Marginal royalties were calculated, for the purposes of this study, using the formulae and data contained in Energy, Mines and Resources, Petroleum Fiscal Systems in Canada: A Summary, October 1983 and information obtained from Energy, Mines and Resources for 1983 and 1984.

9. Alberta Royalty Tax Credit and Alberta Royalty Tax Rebate; ϕ_{gc} and ϕ_{gR}:

The figures for these fiscal parameters, starting respectively in 1974 and 1975, were provided by the Revised Statutes of Alberta, issued in 1980, under the Alberta Income Tax act section, and Foat and MacFadyen, 1983.

10. Rates of Economic Depreciation; δ:

Capital used at both the development and extraction stages are composed of two types of capital: engineering and construction, and equipment and machinery. Economic depreciation rates for each of these two categories are obtained by using the formula $\delta = 2/T$. The figures for T, the service lives of the considered assets, come from Statistics Canada #13-211, Fixed Capital Flows and Stocks for the industrial subdivision of mines, quarries and oil wells for various years.

11. Debt/Equity Ratio; β:

Total debt is defined as the sum of total current liabilities, net long term debt and what is due to shareholders and affiliates. It is then divided by total equity. The relevant information was gathered for oil and gas wells from Statistics Canada #61-207, Corporation Financial Statistics, various years.

12. Expected Rate of Change of the Wellhead Price of Crude Oil; $\dot{p}/p$:

Since the price of crude oil was regulated in Canada over the period considered the actual rate of change of the wellhead price of crude oil is used as the expected one. The average wellhead price of crude oil per cubic meter in Alberta was provided by the Canadian Petroleum Association Statistical Handbook, various years.

13. Rate of Return Required by Shareholders in the Oil Industry; ρ:

This parameter was obtained by adding a risk premium as measured by Parker (1983) for mines and oil wells in Canada to a weighed average of three months Treasury Bills rates (CANSIM Series no. B 14001).

14. Nominal Interest Rate on Bonds; i:

This parameter is the McLeod, Yound, Weir bond yield average for 10 industrials (CANSIM Series no. B 14016).

15. Expected Rate of Inflation; π:

This series was obtained by applying a second-order auto-regressive process to the Consumer price index differenced annually.

B. Personal Side

1. Proportion of Financing done through Debt; β; Proportion of Equity Financing done through Retained Earnings; a.

The data come from Statistics Canada #61-003, Industrial Corporations, various years.

2. Marginal Tax Rates on Dividend Income and Interest Income; θ and m:

A combined federal and provincial marginal tax rate schedule (M_{TR}) is first computed and then applied to the distribution of income from these two sources by income class. For dividends, an additional calculation is then performed:

(1) for 1963-71: $\theta = M_{TR} - .20$

(2) for 1972-84: $\theta = (M_{TR} - S_F (1 - D_P)) (1 + GR)$

where:

S_F: federal tax credit

D_P: provincial tax rate

GR: gross-up rate

3. Marginal Tax Rates on Capital Gains; c:

Following Boadway, Bruce and Mintz's (1984) methodology, it is assumed that the present value of capital gains tax payments on realized capital gains equals the present value of taxes levied on accrued gains. We get the following expression:

$$(3) \quad c = \frac{M_c (e^{Gy} - 1) (G - (\rho + h))}{G (e^{Gy} - e^{(\rho+h)y})}$$

where:

M_c = marginal tax rate on capital income. It is postulated equal to one-half that on dividend income.

G = expected capital gains. It is forecasted by applying a fourth-order auto-regressive scheme to the TSE 300 series differenced quarterly.

y = average holding period of a share. It is postulated equal to 10 years.

h = risk premium = 9.08 (Parker, 1983).

ρ = required rate of return on equity.

We then divide the data obtained for c by two to take into account deferral of capital gains for tax purposes (King and Fullerton, 1984).

All the parameters computed for use at the personal level have been compared to those used by Daly et al. (1985) and are of the same order of magnitude.

APPENDIX 3

TAX RATES

Table A-1

Tax Rates for Exploration Stage without Royalties, Canadian Ownership Rate 2, 1965-84

Year	r^g	r^{g-w}
1981	3.04	-13.75
1982	2.67	-11.39
1983	2.10	-8.95
1984	2.11	-9.93
Average 1965-84	2.73	-9.64

Table A-2

Tax Rates for Exploration Stage with Royalties, Canadian Ownership Rate 2, 1965-84

Year	r^g		r^{g-w}	
	OLD	NEW	OLD	NEW
1981	n.a.	7.80	n.a.	-8.99
1982	3.92	3.08	-10.13	-10.97
1983	2.52	2.29	-8.53	-8.76
1984	2.52	2.24	-9.52	-9.79
Average 1965-84	6.79	14.31	-5.00	1.86

Table A-3

Tax Rates for Exploration Stage without Royalties, Canadian Ownership Rate 3, 1965-84

Year	r^g	r^{g-w}
1981	1.66	-15.13
1982	1.78	-12.27
1983	1.46	-9.66
1984	1.40	-10.64
Average 1965-84	2.55	-9.82

Table A-4

Tax Rates for Exploration Stage with Royalties, Canadian Ownership Rate 3, 1965-84

Year	r^g		$r^g - w$	
	OLD	NEW	OLD	NEW
1981	2.76	2.09	-14.03	-14.70
1982	2.12	1.91	-11.93	-12.14
1983	1.58	1.52	-9.47	-9.53
1984	1.50	1.44	-10.47	-10.50
Average 1965-84	6.22	13.89	-5.90	1.44

Table A-5

Tax Rates for the Development Stage without Royalties, Canadian Ownership Rate 1, Machinery in Southern Alberta, 1965-84

Year	r^t	r^n	r^g	r^g-r^t	r^t-r^n	r^g-r^n
1965	10.24	6.52	5.78	-4.46	3.72	-0.74
1966	10.96	6.53	5.70	-5.26	4.43	-0.83
1967	11.44	5.32	4.62	-6.82	6.12	-0.70
1968	11.50	7.54	5.50	-6.06	3.96	-2.04
1969	12.54	8.04	6.14	-6.40	4.50	-1.90
1970	12.30	7.23	4.98	-7.32	5.07	-2.25
1971	10.41	7.54	5.78	-4.63	2.87	-1.76
1972	11.39	7.17	6.42	-4.97	4.22	-0.75
1973	12.34	5.07	4.30	-8.04	7.27	-0.77
1974	12.92	3.32	2.51	-10.41	9.60	-0.81
1975	12.51	0.96	-2.08	-14.59	11.55	-3.04
1976	11.73	3.54	-1.46	-13.19	8.19	-5.00
1977	12.19	7.51	4.35	-7.84	4.68	-3.16
1978	12.48	5.71	1.69	-10.75	6.77	-4.02
1979	14.10	6.29	1.96	-12.14	7.81	-4.33
1980	14.47	8.99	2.55	-11.92	5.48	--6.44
1981	15.75	8.02	4.23	-11.52	7.73	-3.79
1982	13.49	5.43	-0.36	-13.85	8.06	-5.79
1983	10.79	5.78	0.53	-10.26	5.01	-5.25
1984	12.04	12.47	17.28	5.24	-0.43	4.81
Average 1965-84	12.28	6.45	4.02	-8.27	5.83	-2.43

Table A-6

Tax Rates for the Development Stage with Royalties, Canadian Ownership Rate 1, Machinery in Southern Alberta, 1965-84

Year	r^t	r^n	r^g		$r^g - r^t$		$r^t - r^n$	$r^g - r^n$	
			OLD	NEW	OLD	NEW		OLD	NEW
1977	12.19	7.51	26.00	13.33	13.81	1.14	4.68	18.49	5.82
1978	12.48	5.71	19.71	9.92	7.22	-2.56	6.77	13.99	2.21
1979	14.10	6.29	19.53	9.95	5.43	-4.16	7.81	13.24	3.65
1980	14.47	8.99	11.50	7.39	-2.97	-7.08	5.48	2.51	-1.60
1981	15.75	8.02	23.74	12.62	7.98	-3.13	7.73	15.71	4.60
1982	13.49	5.43	3.52	1.05	-9.58	-12.45	8.06	-1.92	-4.39
1983	10.79	5.78	3.52	1.70	-7.27	-9.01	5.01	-2.26	-4.00
1984	12.04	12.47	19.89	16.72	7.85	4.68	-0.43	7.42	4.25
Average 1965-84	12.28	6.45	12.88	9.20	-0.60	-3.05	5.83	6.43	2.75

Table A-7

Tax Rates for the Development Stage without Royalties, Canadian Ownership Rate 1, Engineering in Northern Alberta, 1965-84

Year	r^t	r^n	r^g	r^g-r^t	r^t-r^n	r^g-r^n
1965	10.24	6.52	7.35	-2.89	3.72	0.83
1966	10.96	6.53	7.25	-3.71	4.43	0.72
1967	11.44	5.32	6.15	-5.25	6.12	0.83
1968	11.50	7.54	7.15	-4.35	3.96	-0.39
1969	12.54	8.04	7.78	-4.76	4.50	-0.26
1970	12.20	7.23	6.64	-5.66	5.07	-0.59
1971	10.41	7.54	7.23	-3.18	2.87	-0.31
1972	11.39	7.17	7.99	-3.40	4.22	0.82
1973	12.34	5.07	5.81	-6.53	7.27	0.74
1974	12.92	3.32	3.71	-9.21	9.60	0.39
1975	12.51	0.96	-0.76	-13.27	11.55	-1.72
1976	11.73	3.54	0.13	-11.60	8.19	-3.41
1977	12.19	7.51	5.51	-6.68	4.68	-2.00
1978	12.48	5.71	2.92	-19.56	6.77	-2.79
1979	14.10	6.29	3.14	-10.96	7.81	-3.15
1980	14,47	8.99	3.86	-19.61	5.48	-5.13
1981	15.75	8.02	5.84	-9.91	7.73	-2.18
1982	13.49	5.43	-0.43	-13.06	8.06	-5.00
1983	10.79	5.78	-1.77	-9.02	5.01	-4.01
1984	12.04	12.47	17.72	5.68	-0.43	5.25
Average 1965-84	12.28	6.45	5.38	-6.85	5.83	-1.07

Table A-8

Tax Rates for the Development Stage with Royalties, Canadian Ownership Rate 1, Engineering in Northern Alberta, 1965-84

Year	r^t	r^n	r^g		$r^g - r^t$		$r^t - r^n$	$r^g - r^n$	
1965	10.24	6.52	11.21		0.98		3.72	4.70	
1966	10.96	6.53	11.09		0.13		4.43	4.56	
1967	11.44	5.32	9.79		-1.65		6.12	4.47	
1968	11.50	7.54	11.09		-0.41		3.96	3.55	
1969	12.54	8.04	11.90		-0.63		4.50	3.87	
1970	12.30	7.23	10.55		-1.76		5.07	3.31	
1971	10.41	7.54	11.08		0.67		2.87	2.20	
1972	11.39	7.17	13.86		2.47		4.22	1.75	
1973	12.34	5.07	10.93		-1.41		7.27	5.86	
1974	12.92	3.32	8.44		-4.48		9.60	5.12	
			OLD	NEW	OLD	NEW		OLD	NEW
1975	12.51	0.96	8.96	2.76	-3.55	-9.75	11.55	-2.00	-8.20
1976	11.73	3.54	12.59	4.99	0.87	-6.73	8.19	10.06	1.46
1977	12.19	7.51	22.85	12.61	10.66	0.43	4.68	15.34	5.11
1978	12.48	5.71	16.85	9.22	4.37	-3.27	6.77	11.14	3.50
1979	14.10	6.29	16.73	9.25	2.63	-4.86	7.81	10.44	2.95
1980	14.47	8.99	10.76	7.52	-3.71	-6.95	5.48	1.77	-1.47
1981	15.75	8.02	20.91	12.12	5.15	-3.53	7.73	12.88	4.10
1982	13.49	5.43	3.11	1.36	-10.39	-12.13	8.06	-2.33	-4.07
1983	10.79	5.78	3.75	2.42	-7.04	-8.37	5.01	-2.03	-3.36
1984	12.04	12.47	9.35	16.75	7.32	4.71	-0.43	7.75	5.14
Average 1965-84	12.28	6.45	12.29	9.45	0.01	-2.83	5.83	5.12	2.23

Table A-9

Tax Rates for the Development Stage without Royalties, Canadian Ownership Rate 1, Engineering in Southern Alberta, 1965-84

Year	r^t	r^n	r^g	r^g-r^t	r^t-r^n	r^g-r^n
1965	10.24	6.52	7.35	-2.89	3.72	4.31
1966	10.96	6.53	7.25	-3.71	4.43	4.18
1967	11.44	5.32	6.15	-5.25	6.12	0.83
1968	11.50	7.54	7.15	-4.35	3.96	-0.39
1969	12.54	8.04	7.78	-4.76	4.50	-0.26
1970	12.20	7.23	6.64	-5.66	5.07	-0.59
1971	10.41	7.54	7.23	-3.18	2.87	-0.31
1972	11.39	7.17	7.99	-3.40	4.22	0.82
1973	12.34	5.07	5.81	-6.53	7.27	0.74
1974	12.92	3.32	3.71	-9.21	9.60	0.39
1975	12.51	0.96	-0.76	-13.27	11.55	-1.72
1976	11.73	3.54	0.13	-11.60	8.19	-3.41
1977	12.19	7.51	5.93	-6.26	4.68	-1.58
1978	12.48	5.71	3.26	-9.22	6.77	-2.45
1979	14.10	6.29	3.57	-10.53	7.81	-2.72
1980	14,47	8.99	4.33	-10.14	5.48	-4.66
1981	15.75	8.02	6.50	-9.25	7.73	-1.52
1982	13.49	5.43	0.86	-12.63	8.06	-4.57
1983	10.79	5.78	2.35	-8.44	5.01	-3.43
1984	12.04	12.47	18.83	6.79	-0.43	6.36
Average 1965-84	12.28	6.45	7.10	-6.67	5.83	-0.50

Table A-10

Tax Rates for the Development Stage with Royalties, Canadian Ownership Rate 1, Engineering in Southern Alberta, 1965-84

Year	r^t	r^n	r^g		$r^g - r^t$		$r^t - r^n$	$r^g - r^n$	
			OLD	NEW	OLD	NEW		OLD	NEW
1977	12.19	7.51	23.71	13.20	11.52	1.01	4.68	16.20	17.88
1978	12.48	5.71	17.55	9.71	5.07	-2.77	6.77	11.94	16.48
1979	14.10	6.29	17.59	9.86	3.49	-4.25	7.81	11.30	17.67
1980	14.47	8.99	11.43	8.08	-3.04	-6.39	5.48	2.44	13.56
1981	15.75	8.02	22.00	12.92	6.25	-2.83	7.73	13.98	20.65
1982	13.49	5.43	3.60	1.79	-9.90	-11.70	8.06	-1.84	9.85
1983	10.79	5.78	4.32	2.94	-6.47	-7.84	5.01	-1.46	7.95
1984	12.04	12.47	20.44	17.75	8.41	5.71	-0.43	7.98	17.32
Average 1965-84	12.28	6.45	12.58	9.67	0.33	-2.58	5.83	6.13	3.22

Table A-11

Tax Rates for the Development Stage without Royalties, Canadian Ownership Rate 2, Machinery in Northern Alberta, 1981-84

Year	r^t	r^n	r^g	r^g-r^t	r^t-r^n	r^g-r^n
1981	15.75	8.02	3.42	-12.33	7.73	-4.60
1982	13.49	5.43	-18.87	-32.36	8.06	-24.30
1983	10.79	5.78	-2.79	-13.58	5.01	-8.57
1984	12.04	12.47	11.61	-0.43	-0.43	-0.86
Average 1965-84	12.28	6.45	2.50	-9.78	5.83	-3.95

Table A-12

Tax Rates for the Development Stage with Royalties, Canadian Ownership Rate 2, Machinery in Northern Alberta, 1981-84

Year	r^t	r^n	r^g		$r^g - r^t$		$r^t - r^n$	$r^g - r^n$	
			OLD	NEW	OLD	NEW		OLD	NEW
1981	15.75	8.02	22.40	11.64	6.64	-4.12	7.73	14.37	-3.61
1982	13.49	5.43	0.02	0.02	-13.47	-13.47	8.06	-5.41	-5.41
1983	10.79	5.78	0.25	-1.32	-10.54	-12.10	5.01	-5.44	-7.09
1984	12.04	12.47	14.33	11.60	2.29	-0.44	-0.43	1.86	-0.87
Average 1965-84	12.28	6.45	12.01	8.56	3.65	-3.69	5.83	5.56	4.11

Table A-13

Tax Rates for the Development Stage without Royalties, Canadian Ownership Rate 2, Machinery in Southern Alberta, 1981-84

Year	r^t	r^n	r^g	r^g-r^t	r^t-r^n	r^g-r^n
1981	15.75	8.02	4.23	-11.52	7.73	-3.79
1982	13.49	5.43	-18.87	-32.36	8.06	-24.30
1983	10.79	5.78	-2.03	-12.82	5.01	-7.81
1984	12.04	12.47	12.92	-0.78	-0.43	0.45
Average 1965-84	12.28	6.45	2.75	-9.54	5.83	-3.70

Table A-14

Tax Rates for the Development Stage with Royalties, Canadian Ownership Rate 2, Machinery in Southern Alberta, 1981-84

Year	r^t	r^n	r^g		$r^g - r^t$		$r^t - r^n$	$r^g - r^n$	
			OLD	NEW	OLD	NEW		OLD	NEW
1981	15.75	8.02	23.74	12.62	7.98	-3.13	7.73	15.71	-4.60
1982	13.49	5.43	0.02	0.02	-13.47	-13.47	8.06	-5.41	-5.06
1983	10.79	5.78	1.00	-0.62	-9.78	-11.41	5.01	-4.77	-6.40
1984	12.04	12.47	15.61	12.78	3.57	0.74	-0.43	3.14	0.31
Average 1965-84	12.28	6.45	12.36	8.84	0.08	-3.42	5.83	5.91	2.39

Table A-15

Tax Rates for the Development Stage without Royalties, Canadian Ownership Rate 2, 1981-1984, Engineering in Northern Alberta

Year	r^t	r^n	r^g	$r^g - r^t$	$r^t - r^n$	$r^g - r^n$
1981	15.75	8.02	5.84	-9.91	7.73	-2.18
1982	13.49	5.43	-12.64	-26.13	8.06	-18.07
1983	10.79	5.78	-0.16	-10.95	5.01	-5.94
1984	12.04	12.47	14.02	1.98	-0.43	1.55
Average 1965-84	12.28	6.45	4.45	-7.83	5.83	-2.00

Table A-16

Tax Rates for the Development Stage with Royalties, Canadian Ownership Rate 2, Engineering in Northern Alberta, 1981-84

Year	r^t	r^n	r^g		$r^g - r^t$		$r^t - r^n$	$r^g - r^n$	
			OLD	NEW	OLD	NEW		OLD	NEW
1981	15.75	8.02	20.91	12.12	-5.15	-3.63	7.73	2.58	4.10
1982	13.49	5.43	0.01	0.01	-13.48	-13.48	8.06	-5.42	-5.42
1983	10.79	5.78	1.85	0.67	8.93	-10.11	5.01	13.94	-5.10
1984	12.04	12.47	15.72	13.41	3.68	1.37	-0.43	3.25	0.94
Average 1965-84	12.28	6.45	11.86	9.12	-0.04	-3.15	5.83	5.02	1.86

Table A-17

Tax Rates for the Development Stage without Royalties, Canadian Ownership Rate 2, Engineering in Southern Alberta, 1981-84

Year	r^t	r^n	r^g	r^g-r^t	r^t-r^n	r^g-r^n
1981	15.75	8.02	6.50	-9.25	7.73	-1.52
1982	13.49	5.43	-12.64	-26.13	8.06	-18.07
1983	10.79	5.78	0.42	-10.37	5.01	-5.36
1984	12.04	12.47	15.13	3.09	-0.43	2.66
Average 1965-84	12.28	6.45	4.68	7.63	5.83	-1.46

Table A-18

Tax Rates for the Development Stage with Royalties, Canadian Ownership Rate 2, Engineering in Southern Alberta, 1981-84

Year	r^t	r^n	r^g		$r^g - r^t$		$r^t - r^n$	$r^g - r^n$	
			OLD	NEW	OLD	NEW		OLD	NEW
1981	15.75	8.02	22.00	12.92	6.25	-2.83	7.73	13.98	4.90
1982	13.49	5.43	0.01	0.01	-13.48	-13.48	8.06	-5.42	-5.42
1983	10.79	5.78	2.42	1.20	-8.37	-9.59	5.01	-3.36	-4.58
1984	12.04	12.47	16.81	14.41	4.77	2.37	-0.43	4.34	1.94
Average 1965-84	12.28	6.45	12.13	9.33	-0.13	-3.21	5.83	5.68	2.88

Table A-19

Tax Rates for the Development Stage without Royalties, Canadian Ownership Rate 3, Machinery in Northern Alberta, 1981-84

Year	r^t	r^n	r^g	r^g-r^t	r^t-r^n	r^g-r^n
1981	15.75	8.02	-0.75	-16.50	7.73	-8.77
1982	13.49	5.43	-3.94	-17.43	8.06	-9.37
1983	10.79	5.78	-4.07	-14.86	5.01	-9.85
1984	12.04	12.47	9.44	-2.60	-0.43	-3.03
Average 1965-84	12.28	6.45	2.87	-6.14	5.83	-3.58

Table A-20

Tax Rates for the Development Stage with Royalties, Canadian Ownership Rate 3, Machinery in Northern Alberta, 1981-84

Year	r^t	r^n	r^g		$r^g - r^t$		$r^t - r^n$	$r^g - r^n$	
			OLD	NEW	OLD	NEW		OLD	NEW
1981	15.75	8.02	15.48	6.57	-0.28	-9.19	7.73	7.45	-1.46
1982	13.49	5.43	-0.51	-2.50	-14.00	-15.99	8.06	-5.94	-7.93
1983	10.79	5.78	-1.01	-2.47	-11.79	-13.26	5.01	-6.78	-8.25
1984	12.04	12.47	12.18	9.63	0.15	-2.41	-0.43	-0.28	-2.84
Average 1965-84	12.28	6.45	11.47	8.03	3.11	-4.23	5.80	5.02	1.58

Table A-21

Tax Rates for the Development Stage without Royalties, Canadian Ownership Rate 3, Machinery in Southern Alberta, 1981-84

Year	r^t	r^n	r^g	$r^g - r^t$	$r^t - r^n$	$r^g - r^n$
1981	15.75	8.02	0.06	-15.69	7.73	-7.96
1982	13.49	5.43	-3.34	-16.83	8.06	-8.77
1983	10.79	5.78	-3.30	-14.09	5.01	-9.08
1984	12.04	12.47	10.74	-1.30	-0.43	-1.73
Average 1965-84	12.28	6.45	3.15	-9.14	5.83	3.30

Table A-22

Tax Rates for the Development Stage with Royalties, Canadian Ownership Rate 3, Machinery in Southern Alberta, 1981-84

Year	r^t	r^n	r^g		$r^g - r^t$		$r^t - r^n$	$r^g - r^n$	
			OLD	NEW	OLD	NEW		OLD	NEW
1981	15.75	8.02	16.81	7.55	1.06	-8.21	7.73	8.79	-0.48
1982	13.49	5.43	0.16	-1.91	-13.33	-15.40	8.06	-5.27	-7.34
1983	10.79	5.78	-0.25	-1.78	-11.04	-12.57	5.01	-6.03	-7.56
1984	12.04	12.47	13.47	10.81	1.43	-1.23	-0.43	1.00	-1.66
Average 1965-84	12.28	6.45	11.85	8.33	-0.42	-3.92	5.83	5.40	1.88

Table A-23

Tax Rates for the Development Stage without Royalties, Canadian Ownership Rate 3, Engineering in Northern Alberta, 1981-84

Year	r^t	r^n	r^g	$r^g - r^t$	$r^t - r^n$	$r^g - r^n$
1981	15.75	8.02	2.42	-13.33	7.73	-5.60
1982	13.49	5.43	-1.75	-15.24	8.06	-7.18
1983	10.79	5.78	-1.12	-11.91	5.01	-6.90
1984	12.04	12.47	12.17	0.13	-0.43	-0.30
Average 1965-84	12.28	6.45	4.68	-7.60	5.83	-1.77

Table A-24

Tax Rates for the Development Stage with Royalties, Canadian Ownership Rate 3, Engineering in Northern Alberta, 1981-84

Year	r^t	r^n	r^g		$r^g - r^t$		$r^t - r^n$	$r^g - r^n$	
			OLD	NEW	OLD	NEW		OLD	NEW
1981	15.75	8.02	15.22	7.96	-0.53	-7.80	7.73	7.20	-0.07
1982	13.49	5.43	0.66	-0.80	-12.83	-14.29	8.06	-4.77	-6.23
1983	10.79	5.78	0.91	-0.20	-9.88	-10.99	5.01	-4.87	-5.98
1984	12.04	12.47	13.90	11.73	1.87	-0.31	-0.43	1.44	-0.74
Average 1965-84	12.28	6.45	11.47	8.75	-0.81	-3.53	5.83	4.27	1.70

Table A-25

Tax Rates for the Development Stage without Royalties, Canadian Ownership Rate 3, Engineering in Southern Alberta, 1981-84

Year	r^t	r^n	r^g	r^g-r^t	r^t-r^n	r^g-r^n
1981	15.75	8.02	3.08	-12.67	7.73	-4.94
1982	13.49	5.43	-1.32	-14.81	8.06	-6.75
1983	10.79	5.78	-0.54	-11.33	5.01	-6.32
1984	12.04	12.47	13.28	-1.24	-0.43	0.81
Average 1965-84	12.28	6.45	4.90	-7.38	5.83	-1.20

Table A-26

Tax Rates for the Development Stage with Royalties, Canadian Ownership Rate 3, Engineering in Southern Alberta, 1981-84

Year	r^t	r^n	r^g		$r^g - r^t$		$r^t - r^n$	$r^g - r^n$	
			OLD	NEW	OLD	NEW		OLD	NEW
1981	15.75	8.02	16.31	8.75	0.55	-7.00	7.73	8.28	0.73
1982	13.49	5.43	1.15	-0.36	-12.34	-13.86	8.06	-4.28	-5.80
1983	10.79	5.78	1.47	0.32	-9.31	-10.46	5.01	-4.30	-5.45
1984	12.04	12.47	14.99	12.74	2.96	0.70	-0.43	2.53	0.27
Average 1965-84	12.28	6.45	11.76	8.97	-0.49	-3.28	5.83	5.31	2.52

Table A-27

Tax Rates for the Development Stage without Royalties, Canadian Ownership Rate 4, Machinery in Southern Alberta, 1981-84

Year	r^t	r^n	r^g	r^g-r^t	r^t-r^n	r^g-r^n
1981	15.75	8.02	-1.16	-16.91	7.73	-9.16
1982	13.49	5.43	-4.34	-17.83	8.06	-1.05
1983	10.79	5.78	-4.58	-15.37	5.01	-10.36
1984	12.04	12.47	8.56	-3.48	-0.43	-3.91
Average 1965-84	12.28	6.45	2.86	-9.42	5.83	-3.15

Table A-28

Tax Rates for the Development Stage with Royalties, Canadian Ownership Rate 4, Machinery in Southern Alberta, 1981-84

Year	r^t	r^n	r^g		$r^g - r^t$		$r^t - r^n$	$r^g - r^n$	
			OLD	NEW	OLD	NEW		OLD	NEW
1981	15.75	8.02	14.79	6.06	-0.97	-9.69	7.73	6.76	-1.96
1982	13.49	5.43	-0.96	-2.90	-14.45	-16.39	8.06	-6.39	-8.33
1983	10.79	5.78	-1.51	-2.94	-12.30	-13.73	5.01	-7.29	-8.72
1984	12.04	12.47	11.33	8.84	-0.71	-3.20	-0.43	-1.41	-3.63
Average 1965-84	12.28	6.45	11.53	8.05	-0.75	-4.20	5.83	5.08	1.60

Table A-29

Tax Rates for the Development Stage without Royalties, Canadian Ownership Rate 4, Engineering in Northern Alberta, 1981-84

Year	r^t	r^n	r^g	r^g-r^t	r^t-r^n	r^g-r^n
1981	15.75	8.02	1.44	-14.31	7.78	-6.58
1982	13.49	5.43	-2.48	-15.97	8.06	-7.91
1983	10.79	5.78	-2.08	-12.87	5.01	-7.86
1984	12.04	12.47	10.32	-1.72	-0.43	-2.15
Average 1965-84	12.28	6.45	4.45	-7.82	5.83	-1.99

Table A-30

Tax Rates for the Development Stage with Royalties, Canadian Ownership Rate 4, Engineering in Northern Alberta, 1981-1984

Year	r^t	r^n	r^g		$r^g - r^t$		$r^t - r^n$	$r^g - r^n$	
			OLD	NEW	OLD	NEW		OLD	NEW
1981	15.75	8.02	13.60	6.77	-2.15	-8.99	7.73	5.58	-1.26
1982	13.49	5.43	-0.16	-1.51	-13.65	-15.01	8.06	-5.59	-6.95
1983	10.79	5.78	-0.04	-1.07	-10.83	-11.86	5.01	-5.82	-6.85
1984	12.04	12.47	12.09	10.06	0.05	-1.98	-0.43	-0.38	-2.02
Average 1965-84	12.28	6.45	11.21	8.53	-1.07	-4.64	5.83	3.99	0.37

Table A-31

Tax Rates for the Development Stage without Royalties, Canadian Ownership Rate 4, Engineering in Southern Alberta, 1981-84

Year	r^t	r^n	r^g	r^g-r^t	r^t-r^n	r^g-r^n
1981	15.75	8.02	2.10	-13.65	7.73	-5.92
1982	13.49	5.43	-2.04	-15.53	8.06	-7.47
1983	10.79	5.78	-1.51	-12.30	5.01	-7.29
1984	12.04	12.47	11.43	-0.61	-0.43	-1.04
Average 1965-84	12.28	6.45	4.68	-7.60	5.83	-1.43

Table A-32

Tax Rates for the Development Stage with Royalties, Canadian Ownership Rate 4, Engineering in Southern Alberta, 1981-84

Year	r^t	r^n	r^g		$r^g - r^t$		$r^t - r^n$	$r^g - r^n$	
			OLD	NEW	OLD	NEW		OLD	NEW
1981	15.75	8.02	14.70	7.57	1.06	-8.18	7.73	8.79	-0.45
1982	13.49	5.43	0.33	-1.08	-13.16	-14.58	8.06	-5.10	-6.52
1983	10.79	5.78	0.53	-0.55	-10.26	-11.34	5.01	-5.25	-6.33
1984	12.04	12.47	13.18	11.06	1.14	-0.97	-0.43	0.98	-1.40
Average 1965-84	12.28	6.45	11.50	8.75	-0.65	-3.50	5.83	5.05	2.30

Table A-33

Tax Rates for the Extraction Stage without Royalties, Machinery in Southern Alberta, 1965-84

Year	r^t	r^n	r^g	r^g-r^t	r^t-r^n	r^g-r^n
1965	10.05	6.52	2.83	-7.22	3.53	-3.69
1966	10.74	6.53	2.80	-7.94	4.21	-3.73
1967	11.26	5.32	1.72	-9.54	5.94	-3.60
1968	11.20	7.54	2.10	-9.09	3.66	-5.44
1969	12.23	8.04	2.92	-9.30	4.19	-5.12
1970	12.03	7.23	1.55	-10.48	4.80	-5.68
1971	10.20	7.54	3.18	-7.02	2.66	-4.36
1972	11.19	7.17	3.57	-7.62	4.02	-3.60
1973	12.09	5.07	1.35	-10.74	7.02	-3.72
1974	12.56	3.32	0.24	-12.32	9.24	-3.08
1975	12.14	0.96	-4.53	-16.68	11.18	-5.49
1976	11.16	3.54	-5.13	-16.29	7.62	-8.67
1977	11.77	7.51	1.52	-10.25	4.26	-5.99
1978	12.01	5.71	-1.47	-13.48	6.30	-7.18
1979	13.52	6.29	-1.18	-14.69	7.23	-7.47
1980	13.67	8.99	-1.44	-15.11	4.68	-10.43
1981	15.75	8.02	4.23	-11.53	7.73	-3.79
1982	13.49	5.43	-0.36	-13.85	8.06	-5.79
1983	10.79	5.78	0.53	-10.25	5.01	-5.25
1984	12.04	12.47	17.28	5.24	-0.43	4.81
Average 1965-84	11.99	6.45	1.59	-10.41	5.55	-5.34

Table A-34

Tax Rates for the Extraction Stage with Royalties, Machinery in Southern Alberta, 1965-84

Year	r^t	r^n	r^g		$r^g - r^t$		$r^t - r^n$	$r^g - r^n$	
			OLD	NEW	OLD	NEW		OLD	NEW
1977	11.77	7.51	73.68	20.90	61.91	9.13	4.26	66.17	13.39
1978	12.01	5.71	55.41	15.07	43.40	3.06	6.30	49.70	9.36
1979	13.52	6.29	52.42	16.60	38.91	3.09	7.23	46.14	10.32
1980	13.67	8.99	21.22	9.27	7.54	-4.40	4.68	12.22	0.28
1981	15.75	8.02	50.05	22.89	34.30	7.14	7.73	42.03	14.87
1982	13.49	5.43	9.22	4.89	-4.27	-8.60	8.06	-3.79	16.66
1983	10.79	5.78	15.54	10.77	4.76	-0.02	5.01	9.77	4.99
1984	12.04	12.47	43.91	35.36	31.38	23.32	-0.43	30.95	22.89
Average 1965-84	11.99	6.45	24.18	11.62	12.16	-0.38	5.55	17.73	5.17

Table A-35

Tax Rates for the Extraction Stage without Royalties, Engineering in Northern Alberta, 1965-84

Year	r^t	r^n	r^g	r^g-r^t	r^t-r^n	r^g-r^n
1965	10.05	6.52	5.08	-4.97	3.53	-1.44
1966	10.74	6.53	5.01	-5.73	4.21	-1.52
1967	11.26	5.32	3.90	-7.36	5.94	-1.42
1968	11.20	7.54	4.57	-6.63	3.66	-2.97
1969	12.23	8.04	5.38	-6.85	4.19	-2.66
1970	12.03	7.23	4.06	-7.97	4.80	-3.17
1971	10.20	7.54	5.16	-5.03	2.66	-2.38
1972	11.19	7.17	5.85	05.35	4.02	-1.32
1973	12.09	5.07	3.49	-8.66	7.02	-1.58
1974	12.56	3.32	1.71	-10.85	9.24	-1.61
1975	12.14	0.96	-2.99	-15.13	11.18	-3.95
1976	11.16	3.54	-3.00	-14.16	7.62	-6.54
1977	11.77	7.51	3.18	-8.59	4.26	-4.33
1978	12.01	5.71	0.26	-11.76	6.30	-5.45
1979	13.52	6.29	0.47	-13.05	7.23	-5.82
1980	13.67	8.99	0.57	-13.10	4.68	--8.42
1981	15.75	8.02	5.22	-10.54	7.73	-2.80
1982	13.49	5.43	-0.14	13.63	8.06	-5,57
1983	10.79	5.78	1.07	-9.71	5.01	-4.71
1984	12.04	12.47	17.02	4.98	-0.43	4.55
Average 1965-84	11.99	6.45	3.29	-7.34	5.55	-3.16

Table A-36

Tax Rates for the Extraction Stage with Royalties, Engineering in Northern Alberta, 1965-84

Year	r^t	r^n	r^g		$r^g - r^t$		$r^t - r^n$	$r^g - r^n$	
1965	10.05	6.52	8.38		-2.88		3.53	0.65	
1966	10.74	6.53	9.50		-1.70		4.21	2.51	
1967	11.26	5.32	10.62		-1.60		5.94	4.34	
1968	11.20	7.54	9.08		-2.95		3.66	0.71	
1969	12.23	8.04	9.79		-0.40		4.19	3.79	
1970	12.03	7.23	13.27		2.08		4.80	6.88	
1971	10.20	7.54	9.91		-2.18		2.66	0.48	
1972	11.19	7.17	6.50		-6.06		4.02	-2.04	
1973	12.09	5.07	17.58		5.43		7.02	12.45	
1974	12.56	3.32	39.80		28.64		9.24	37.88	
			OLD	NEW	OLD	NEW		OLD	NEW
1975	12.14	0.96	61.16	18.75	49.39	6.61	11.18	60.58	17.79
1976	11.16	3.54	44.27	13.05	32.26	1.89	7.62	39.88	9.51
1977	11.77	7.51	41.91	14.22	28.39	2.45	4.26	32.65	6.71
1978	12.01	5.71	18.27	8.94	4.60	-3.07	6.30	10.90	3.23
1979	13.52	6.29	41.43	19.97	25.68	6.45	7.23	32.92	13.78
1980	13.67	8.99	6.62	3.57	-6.87	-10.10	4.68	-2.19	-5.42
1981	15.75	8.02	12.03	8.54	-3.72	-7.21	7.73	4.01	0.52
1982	13.49	5.43	38.89	31.86	-25.40	-18.37	8.06	-17.32	-10.31
1983	10.79	5.78	9.75	8.36	-1.04	-2.43	5.01	2.97	2.67
1984	12.04	12.47	9.67	8.32	-2.37	-3.72	-0.43	-2.80	-4.15
Average 1965-84	11.99	6.45	20.92	13.50	5.96	-0.46	5.55	14.47	7.05

Table A-37

Tax Rates for the Extraction Stage without Royalties, Engineering in Southern Alberta, 1965-84

Year	r^t	r^n	r^g	r^g-r^t	r^t-r^n	r^g-r^n
1965	10.05	6.52	5.08	-4.97	3.53	-1.44
1966	10.74	6.53	5.01	-5.73	4.21	-1.52
1967	11.26	5.32	3.96	-2.36	5.94	-1.42
1968	11.20	7.54	4.57	-6.63	3.66	-2.97
1969	12.23	8.04	5.38	-6.85	4.19	-2.66
1970	12.03	7.23	4.06	-7.97	4.80	-3.17
1971	10.20	7.54	5.16	-5.03	2.66	-2.38
1972	11.19	7.17	5.85	-5.35	4.02	-1.32
1973	12.09	5.07	3.49	-8.60	7.02	-1.58
1974	12.56	3.32	1.71	-10.85	9.24	-1.61
1975	12.14	0.96	-2.99	-15.13	11.18	-3.95
1976	11.16	3.54	-3.00	-14.16	7.62	-6.54
1977	11.77	7.51	3.62	-8.15	4.26	-3.89
1978	12.01	5.71	0.62	-11.39	6.30	-5.09
1979	13.52	6.29	0.93	-12.59	7.23	-5.36
1980	13.67	8.99	1.08	-12.60	4.68	-7.91
1981	15.75	8.02	5.88	-9.88	7.73	-2.14
1982	13.49	5.43	0.30	-13.20	8.06	-5.13
1983	10.79	5.78	1.65	-9.13	5.01	-4.13
1984	12.04	12.47	18.13	6.09	-0.43	5.66
Average 1965-84	11.99	6.45	3.52	-8.47	5.55	-2.93

Table A-38

Tax Rates for the Extraction Stage with Royalties, Engineering in Southern Alberta, 1965-84

Year	r^t	r^n	r^g		$r^g - r^t$		$r^t - r^n$	$r^g - r^n$	
			OLD	NEW	OLD	NEW		OLD	NEW
1977	11.77	7.51	63.17	19.62	51.40	7.84	4.26	55.66	12.10
1978	12.01	5.71	45.82	13.76	33.81	1.75	6.30	40.11	7.95
1979	13.52	6.29	43.74	15.13	30.23	1.61	7.23	37.46	8.84
1980	13.67	8.99	19.37	9.72	5.69	-3.95	4.68	10.37	0.73
1981	15.75	8.02	43.30	21.12	27.64	5.37	7.73	35.37	13.10
1982	13.49	5.43	7.28	4.13	-6.21	-9.37	8.06	1.85	-1.31
1983	10.79	5.78	12.97	9.37	2.18	-1.42	5.01	7.19	3.59
1984	12.04	12.47	40.73	33.47	28.69	21.43	-0.43	28.26	21.00
Average 1965-84	11.99	6.45	25.81	18.31	13.67	2.51	5.55	19.36	11.86

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